FARMERS DIGEST

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The Farmer's Digest

From more than two hundred magazines and bulletins published in this country and abroad, the Editorial Staff of the Farmer's Digest selects articles of outstanding merit and general interest. It is comprehensive in its scope, covering all phases of Agriculture.

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EDITORIAL STAFF—Editor, L. Bush-Brown
Assistant Editor—C. Leavitt Dyer
Associate Editors: John A. Andrew, Jr., A. E. Heick, R. L. Patrick, Ph. D.

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EDITORIAL STAFF

Editor—L. Bush-Brown, Director of the School of Horticulture
Associate Editors—J. A. Andrew, Jr., M.S. C. L. Dyer, B.S. R. L. Patrick, Ph.D.

The Farmer's Digest

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Functions of Organic Matter in Plant Nutrition

Condensed from California Cultivator

R. E. Stephenson

SOILS that have been cultivated for twenty-five years or more have lost from one-fourth to one-third their virgin supply of humus or organic matter. New land loses humus rapidly when first put under the plow. After a short time the rate of loss is very much slower. During the period of rapid loss the soil is adjusting itself to a new base level under the environment of cultivation. This adjustment is a natural sequence to tillage. Crop yields not infrequently fall off somewhat in proportion to the loss of humus. The only preventive for reduced yields is frequent humus renewal with rotation, manure, green manures and residues.

The increased rate at which humus is lost under tillage is due to the effect of cultivation in speeding up biological processes. Rapid decay exhausts the soil but decay is desirable because more soluble plant nutrients are liberated to make bigger crops. A few big crops and reduced production is logical. Only the best methods to supply fresh humus and mineral fertilizers can keep up yields. For humus renewal sod crops, both legumes and grasses are unsurpassed. To make a good rotation without them is difficult.

No satisfactory substitute for humus has been found. Mineral fertilizers supplement but do not replace it. Humus serves as a reservoir of plant food. When the soil is moist and warm crops grow vigorously. The same conditions speed up decay and more nutrients are liberated to speed crop growth. A dry spell checks plant growth. The rotting of humus is slowed down at the same time and a surfeit of available nutrients is averted. Under the same circumstances a mineral fertilizer would remain in the soil

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317 Central Ave., Los Angeles, Cal.

solution, raising the concentration so high that burning or "firing" of the growing plants might occur.

How important is humus as a source of nutrients for crops? Nutrients that come from the soil are placed in two groups. One group supplies nitrogen, sulphur, phosphorus, carbonates and bicarbonates. The other group includes calcium, magnesium, potash and iron. The first group except phosphate (which comes in part from minerals) comes almost entirely from humus decay. The second group is not dissolved, and neither can it be held in soluble form except through decay of humus. It is the soluble nitrates, sulphates, and bicarbonates of the first group which nourish the crop.

Mineral fertilizers are more effective after the humus is renewed. Manure and fertilizers together are preferable to either alone. The Maryland station obtained from a fifth to a third more with the two together than with double the amount of either alone on truck crops. Wherever soils are exhausted, the first problem is humus renewal. The best soils respond likewise to manuring with fresh humus materials, and must be regularly renewed to maintain production.

Humus does other things than supply nutrients. It modifies soil structure. A mellow soil is made up of crumbs or clumps held together in a granule. Humus furnishes binding material for the soil crumb. Such a structure permits easy root penetration, and rapid renewal of moisture and nutrients. Roots go to the water and food in the soil, not vice versa. When the humus is burned out the soil crumbs fall apart and the particles become structureless. The soil is tight and compact when wet and hard when dry. Root penetration is restricted and nutrition of the crop is limited.

So important is humus to the soil structure that dissolving it in the laboratory with chemicals causes the soil to analyze two to four times as much clay. This is due to the crumb structure which cannot be broken up as long as the humus is intact. Dissolving the humus breaks the crumbs. Abundant humus therefore gives to the soil the properties of a lighter mixture. With 20 per cent humus, soils become loose and fluffy with physical properties more like peats than mineral soils.

Worn out soils become drouthy due to the loss of humus. From 20 to 40 per cent of the capacity of soils to hold moisture is due to their humus. Because of loss of structure water penetrates the soil less readily, and is evaporated more quickly. The same amount of water is less efficiently

used because of low fertility. In dry seasons the high humus soils remain moist in the lower horizons and crop growth is correspondingly better.

Humus is the product of the activities of soil micro-organisms. Placing organic matter in the soil may be compared to putting feed in the manger. A green crop plowed under feeds the micro-organisms in as real a sense as hay feeds the animals. Humus is a mixture of products including the important plant nutrients which accumulate from feeding organisms. Animal feeds must be nutritious and well balanced to make a good ration. Food for organisms must be high in nitrogen if satisfactory results are to follow. The organisms need minerals also and there must be sufficient for both them and the crops.

Soil organisms use the carbon of plant residues for energy and to make protoplasm. The energy carbon is evolved from the soil as carbon dioxide. The evolved gas enriches the air about the plant leaves and stimulates the photosynthetic activity of the plants. Nitrogen is used by the bacteria, fungi and other organisms to combine with carbohydrate to make protoplasm. Nitrogen in excess of the needs of the organisms is left in the soil in the form of ammonia or nitrates to furnish the nitrogen for crop growth. This is the only source of nitrate for plants except when commercial nitrate is used.

Good humus materials therefore must have nitrogen sufficient for the organisms with an excess for the crop. Crops and organisms compete more severely for nitrogen than for any other nutrient. Investigations have shown that 1.7 per cent nitrogen just about meets the needs of organisms. With 2 per cent there is some excess and with 3 per cent there is a ready surplus. Materials containing smaller amounts of nitrogen do not meet the needs of organisms, and all available nitrogen which is already in the soil is exhausted to make up the deficiency. Then crops fail to grow unless commercial nitrate is used.

This explains the poor results from straw used to make humus. Straw contains only .5 per cent of nitrogen and to make humus satisfactorily the organisms need 1.5 per cent more nitrogen. With the extra nitrogen added straw makes as good humus and as much of it, as alfalfa or clover hay. Green manures make good humus because they are rich in nitrogen, sometimes carrying 3 to 4 per cent. The green materials decay quickly and furnish an abundance of available nitrate for both the organisms and the crop.

Humus processes are continu-

ous in the soil. They are most active in warm, moist weather. Crops grow most rapidly under the same conditions and partly for the same reasons. Not bulk or quantity of humus, so much as the active changes occurring in it, liberates plant food and stimulates the growth of plants. The vigorous action following addition of fresh materials is necessary to insure big yields. That is why virgin soils are very productive, and continue so only as long as the humus is renewed.

White Oak Quail Farm

Condensed from The Southern Planter

JUST south of Richmond, Virginia, on U. S. Highway Route 1, William B. Coleman, White Oak Quail Farm, has reared over 10,000 quail annually under artificial conditions for the past five years. He sells them for restocking and experimental purposes throughout the United States and Europe for around $5 a pair. There is always a keen demand for his birds.

But Mr. Coleman is no novice at quail rearing. He has been in the business for 25 years, was a pioneer in the game, and is today one of the best known quail authorities in America. He has developed rearing methods that make the raising of quail in captivity as safe as any other poultry, and a great deal more profitable.

It was twenty-five years ago—back in 1913—that William B. Coleman first attracted the attention of game conservation officials. As a shy country lad from Amelia County, Virginia, he exhibited 18 quail at the State Fair in Richmond which he had reared in captivity with a Bantam hen. Two things happened that week to young Billy Coleman that have had a profound bearing on game conservation and restoration. First, Billy made friends with several State and National wildlife enthusiasts who saw in his successful experiment the possibilities of rearing quail under artificial conditions in quantity for restocking purposes. And second, his project received wide publicity because Amelia officers threatened to arrest him for shipping quail out of the county.

An exclusive New York sportsman's club immediately hired Billy to rear quail in captivity for liberation on their 66,000-acre

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shooting preserve in South Carolina. The severe winter and heavy snows of 1917-18 caused enormous losses of native quail in Virginia and adjoining states, and the Old Dominion sent for Billy to come home and lend a hand in the restocking process. He was placed in charge of the Virginia State Game Farm where he further perfected his brooding technique—discarded his Bantam hens and turned to electric incubators and brooders. He developed a suitable mash feed for the fluffy little fellows, and worked out management methods that increased egg production, improved hatchability and reduced mortality. In 1929 Mr. Coleman left the State Game Farm and began his present commercial venture at White Oak Quail Farm. His ambition was to rear 10,000 quail in a single year. In 1933 he passed that mark for the first time by producing 13,182 quail. He has averaged 10,000 birds a year ever since.

The birds are mated in early spring—one male and one female in each wire bottom cage. Egg laying begins around April 10 and may continue through September. Each laying pen is provided with a nest, clean drinking water, grit—sand, charcoal and oyster shell—green feed, a grain mixture, a specially prepared laying mash and a hover for protection from the weather. The dropping boards, feed and water vessels are cleaned regularly as a caution against disease. The best females lay 100 eggs per season and over. The eggs are collected once a week—on Monday—and placed in the incubator. At the peak of the laying season as many as 1,700 eggs are collected each week. Over 20,000 eggs were set last season.

It is interesting to note that under natural conditions the female quail lays only about 18 to 20 eggs a season, and raises only one brood of birds. If this clutch of eggs or the young birds hatched from them are destroyed, a second or even third clutch may be laid. These late broods account for the frequent reports of small, immature birds at the start of the hunting season. Wild quail do not raise more than one brood of birds in a season. But Mr. Coleman has improved on nature. He has kept hens until 10 years old, and some of them have established remarkable egg-laying records.

We saw one old bird, hatched August, 1931, that has the following production record to her credit and is still going strong:

1932—107 eggs	1935—120 eggs
1933—125 eggs	1936—113 eggs
1934—144 eggs	1937—100 eggs

A regular electric hen egg incubator, with trays adapted with mesh wire to hold the tiny eggs, is used for hatching. Except that

the quail eggs require a slightly higher humidity, the operation of the incubator is identical to that required for hen eggs. Quail eggs hatch in 22 to 24 days. Thus a batch of eggs go into the incubator each Monday and a hatch of little birds are taken off each Wednesday. When first hatched, the fluffy little fellows are about the size of bumblebees. They are transferred to small brooders when a few hours old.

Each brooder will accommodate 50 birds, and is heated by electricity. The temperature is controlled by a thermostat adjusted to maintain regular baby chick temperatures — approximately 100 degrees at first and reduced as birds grow older. All of the sanitary precautions advocated for baby chicks are taken. The mortality rate is remarkably low. A 26 per cent protein mash is kept before the birds. Mr. Coleman developed a quail growing mash mixture that is now being used by quail breeders throughout the country. The birds grow by leaps and bounds and at 5 weeks of age are ready to go on range. They are fairly well feathered at that age.

On the range the birds are placed in large screen wire coops. These are moved to new ground every day to prevent disease. At the end of the laying season breeders are grouped in coveys and put on the range. Older birds on range are changed to new ground every second day. Specially constucted coops equipped with handles make moving a very simple task. The land is plowed once a year to turn under the droppings which might carry disease.

Some of the birds are sold in fall, a few during the winter months and the balance in early spring. Some of the best individuals are saved for replacements in the breeding pens. Mr. Coleman has developed a shipping box that will accommodate 16 to 18 birds, and insure their safe shipment around the world. It has a compartment for feeds, water and greens; is equipped with removable dropping boards; and has special ventilating features to prevent over-heating and provide fresh air. When the birds reach their destination Mr. Coleman advises that the box be placed in the field, some grain scattered around and the slide door opened so that the birds can quietly walk out into the open to establish a new home undisturbed.

Mr. Coleman is also experimenting with several Old World partridges and some of them show considerable possibilities as game birds for this country. The Chukar partridge from the highlands of India has reproduced rapidly in captivity for Mr. Coleman and he believes it may

thrive in some of our rough country where the Bob White has failed to do well. Chukar resembles our domestic quail except that it weighs around 20 ounces against an average of 6 to 8 ounces for the Bob White. From 13 Chukar hens Mr. Coleman raised 700 birds in one year. Several of the hens laid over 100 eggs that season.

The Hungarian partridge is also under test at White Oak. It is considerably smaller than the Chukar and seems more adapted to the far West and to Canada than to the Southern States. Game officials, however, are eagerly watching Mr. Coleman's progress with both of these birds new to America.

We asked Mr. Coleman what in his opinion was the greatest enemy of the Bob White under natural conditions.

"The self-hunting dog, by all means," he said. "A quail can safely hide from a hawk. Cover, adequate cover, is the answer to the hawk. But there is no escape from the self-hunting dog. The dog can scent the quail, suck the eggs, destroy the young birds and practically eradicate the Bob White from a whole community."

"What about the man with the gun?" we asked.

"That's why we raise the quail. Hunting the quail with a good dog on a crisp autumn day is just about the finest sport in the world. But man hunts the adult bird, and gives it a sporting chance. If through education we can impress upon hunters the importance of leaving plenty of breeding stock each year; restocking breeders if necessary; encourage land owners to leave ample cover and feed them in severe weather; and require dog and cat lovers to restrict the range of their animals, the Bob White's future is assured."

COLTS fed oats, bran, and alfalfa developed better legs than colts fed corn and alfalfa in Illinois tests, reports E. T. Robbins, livestock extension specialist, College of Agriculture, University of Illinois.

Late Keeping Grapes

Condensed from American Agriculturist

G. L. Slate

CONCORD, Niagara, Delaware and Worden are the grapes usually grown in the average fruit garden. These are very desirable grapes in their season, but unfortunately they may be kept only a few weeks after harvesting, or not much later than Thanksgiving at best. By a proper selection of varieties grapes may be had that will keep until New Years, or even much later under good conditions. Several of the lesser known older varieties and some of the newer varieties possess unusually good keeping quality.

Grapes to keep well must be well grown, that is, they must be well ripened and free from mildew. Vigorous, healthy vines, not overloaded, and sprayed to control disease will produce fruit of excellent keeping quality. The fruit should remain on the vines until fully ripe and usually until just before the first killing frost is expected.

Remove the clusters carefully to avoid bruising, trim out all diseased or bruised berries, and lay them one layer deep in shallow trays with slatted or wire netting bottoms to facilitate air circulation. The storage room should be well ventilated, as stagnant air invites mildew and rot. Temperatures should be maintained as near 32° F. as can be managed, although good results may be had at somewhat higher temperatures, preferably not over 40° F. If the storeroom is dry, a few pails of water standing in the room will tend to increase the humidity and reduce shriveling of the fruit.

If only one late keeping variety is to be grown, Sheridan is probably most satisfactory. This is a large, compact clustered blue grape of very fine flavor and handsome appearance. It ripens a week or ten days later than Concord, and where seasons are short it should be grown in a warm spot such as the south side of a building or wall. Sheridan tends to overbear and not over 20 to 25 buds should be left for fruiting. An overloaded vine will certainly fail to ripen its crop properly.

Two very fine flavored, firm, meaty textured red varieties suggestive of the California grape are Urbana and Keuka. Both must have a season long enough to ripen Catawba. Urbana needs

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thorough spraying to control downy mildew, and Keuka must not be allowed to overbear.

Seneca is a very early greenish yellow grape of fine keeping quality. In fact, it is the only grape known to the writer that will ripen around September 1st, yet keep until Christmas. The flavor is very sweet and rich, the berries and clusters are of medium size.

Older varieties still worth growing for their fine flavor and keeping quality are Agawam, Lindley, Salem and Barry. They need cross-pollination and should be grown near other varieties such as Concord, Niagara or Sheridan.

What Happens to Herd Sires?

Condensed from Hoard's Dairyman

D. M. Seath

THE more one delves into the herd sire problem the more complicated the problem becomes. This, at least, is the conclusion that can be drawn from an examination of dairy herd improvement association records accumulated over a period exceeding ten years in Kansas.

Not only is it a problem to find a good proved sire, but it is doubly difficult to have these sires actively in service at the time they are discovered. This has been the experience in the past. The 159 proved sires studied reached the average age of nine years before enough data was gathered and computed to prove them. The youngest age at which any sire was proved was five years. At the other extreme, six sires were first proved after they had reached the age of 16 years.

The advanced age at which many of the sires were proved can be partly attributed to the fact that records were not promptly computed nor were enough of the herd owners interested in the proved sire program. In addition, the large number of small herds in which these sires were used with the correspondingly small number of daughters which would freshen in any one year partially accounts for the advanced age which the sires reached before they were proved.

Recent months have witnessed an added interest in the proved sire program which is now result-

Reprinted by permission from Hoard's Dairyman, Fort Atkinson, Wisconsin

ing in proving sires at a much younger age than was done formerly.

Having a bull alive after he is proved seems as difficult as is the chore of placing promising young sires in herds where a continuous testing program will be followed. The information as to whether or not the bulls were dead or alive when proved was secured on 138 sires. Only 56 or 41 per cent were alive when proved, while the other 82, representing 59 per cent, were proved after they were dead.

One encouraging fact was that 36 of the 138 sires, representing 26 per cent, proved good and were alive at the time. When analyzed this shows that 64 per cent of those that were still alive when proved were "good."

Where do herd sires go? A tabulation of these answers secured on 98 sires, revealed that only 15 per cent of them were sold to other breeders, 67 per cent were sold as beef, while 17 per cent died. The relatively small number that went to other breeders is one of the reasons why so few bulls were alive when proved.

Why are bulls sold before they are proved? The answer to this question was received on 84 of the proved sires. Their owners said that 42 per cent of the bulls were sold in order to avoid inbreeding while 19 per cent of the sires became non-breeders. Detailed results of this study are indicated in Table I.

The health of the animal (including ailments such as crippled, TB, lumpy jaw, poor health) represents reasons for the disposal of 17 per cent of the bulls. More knowledge as to the proper care of herd sires to prevent them becoming diseased or injured certainly seems in order after examining these results. The fact that 42 per cent were sold to avoid inbreeding would cause some students of animal breeding to say that more universal line-breeding or inbreeding probably would cause less of a setback to breed improvement than has the program as it has been practiced. Their contention would probably be true if most sires so used were transmitting a preponderance of desirable factors to their offspring.

Information as to how much longer the average sire would need to remain in a herd to be

Table I

Why Disposed of (Data on 84 Bulls)

	No. bulls	Per cent
To avoid inbreeding ...	35	42
Became a non-breeder .	16	19
Poor daughters	6	7
Animal became crippled	6	7
Bull was vicious	9	10
T. B. Reactor	3	4
Lumpy Jaw	2	2
Herd dispersed	1	1
Poor health	3	4
Poor individual	3	4

proved was next sought. The answer to this question was sought from the ages when breeders dispose of their sires. The data as presented in Table II show that 84 bulls were disposed of at an age averaging 6½ years. This average is high enough so that a large percentage of the bulls could have been proved first. Whenever the sires were used in large herds, this would have been particularly possible. Only 13 per cent of these 85 sires were kept in herds after they were nine years of age which was previously found the average age that the bulls were proved. As contrasted to this, 70 per cent of them went to market between the ages of four and seven years.

A partial remedy to this condition could be affected by a more universal exchange of sires between breeders. Some are solving it through the organization of bull clubs. Larger herds are gradually working toward such a solution through the adoption of a program where two or more sires are used. Dairymen wishing to make future progress with their breeding operations will do well to consider solutions to these problems.

Table II
Age When Disposed of
(Data on 85 Bulls)

Age in years	No. of bulls	Per cent
3	3	4
4	13	15
5	20	23
6	14	17
7	13	15
8	9	11
9	2	2
10	4	5
11	4	5
14	1	1
15	1	1
16	1	1

Average—6.5 years

Increasing An Inadequate Farm Water Supply

Condensed from Electricity on the Farm

Dr. Forrest B. Wright

Asst. Professor of Agricultural Engineering, Cornell University

MORE water is used when it is available under pressure from an automatic water system than when it must be pumped or carried. Because of this it sometimes happens that a well or other source of supply, which was quite adequate with a hand pump is inadequate when an automatic water system is installed.

If the flow of a spring is weak in dry weather, it is probably caused by a lowering of the ground water level or a depletion of the flow through the subsoil. Under this condition, the effective supply may be increased by providing a storage reservoir located far enough below the spring to allow a free flow of water from it. The water should not be dammed up at the spring as any raising of the water level will decrease the flow.

With the reservoir below the spring the best possible flow may be had from the spring, and even though this be little more than a trickle, if it is all collected in the storage tank, the amount of water which will accumulate in 24 hours may be surprising.

Do not attempt to increase the flow of a spring by use of dynamite. This practice frequently results in a complete loss of the spring.

In case the spring is located in a marshy area at the base of a slope, the flow may be increased by installing drain tile through the marsh at the base of the slope. This drain tile will collect the water where it seeps out at the base of the slope and lead it to the storage reservoir. The tile should be laid in gravel at a depth of about 4 feet and covered with clay. The entire area so drained should be fenced off to exclude animals and a diversion ditch constructed at the base of the slope to divert surface water. Water from such springs should be tested by a health officer as there is some likelihood of contamination.

A storage reservoir at a spring for household supply should be about 4x4x6 feet or have roughly a storage capacity of 100 cubic

Reprinted by permission from Electricity on the Farm, August, 1938,
24 West 40th St., New York City

feet. Such a reservoir should be well protected from pollution by surface water.

If there is plenty of water at the spring and adequate storage, but not enough water or pressure at the end of the pipe line, the pipe may be too small. This situation can be remedied (1) by installing a larger pipe; (2) by building a reservoir near the buildings or in the basement, into which the spring is allowed to flow continuously. The water can then be pumped from the reservoir to the house service by means of a shallow well pumping system.

Where the distance from the spring to the buildings is not great (three or four hundred feet) the least expensive method would be to install larger pipe. If the spring is a considerable distance away, it would probably be cheapest to build the reservoir at the buildings and install a shallow well pump, using the existing pipe line to carry the water to the reservoir continuously.

Dug Wells

When a dug well becomes inadequate, the supply may be increased (1) by enlarging the diameter of the well or digging it deeper, to increase the storage capacity; or (2) drilling deeper through the bottom of the well. This may be desirable where the dug well is not adequately cased or where rock occurs at the bottom.

A third method of increasing the supply, where the water in the dug well is in a porous stratum within 20 feet of the ground surface, is to use driven well points.

If experiences of others in the neighborhood have shown that drilling deeper is likely to get salt, gypsum or sulphur water, the best plan would be to dig or drive another shallow well or build a cistern as a supplemental supply.

Driven Wells

With driven wells, the most likely method of increasing the supply is to drive one or more additional well points 25 to 50 feet apart and preferably to the same depth as the old well. Where driven wells are used, the water is usually in a bed of water-bearing sand or gravel, and flows into the driven pipe through a strainer at the bottom. The addition of more pipes in the water-bearing stratum taps this water reservoir at more points, thus increasing the total rate of flow.

The driven well may be also supplemented by a dug well which would provide storage capacity.

Where water in the new well or cistern is about on a level with that in the old well, one pump may be used to pump from both

sources. Unless the water in both wells is exactly at the same level and both supply water at the same rate, valves should be placed on the suction lines, so that the flow from each source can be regulated. Such valves should be of the gate type and should have good packing around the stems to prevent air leaks. Should there be considerable difference in level between the two sources, the pumping may have to be done alternately from one well and then the other, or an extra pump may need to be installed.

Drilled wells which fail to respond to increasing demands may sometimes be improved by drilling deeper. A good well driller should be consulted before this is attempted. It is also advisable to consult the neighbors who have wells to see at what depths they have obtained water. In some localities it is necessary to go to extreme depths to get an abundant flow of water.

If the well is an old one the flow may have been greatly decreased by sediment in the bottom. The sediment can be bailed out by means of a well driller's bail. If the sediment is very fine clay, it may require some time for the flow to increase after bailing because of the clay in the pores of the rock. Do not attempt to increase the flow by blasting with dynamite.

With weak wells, the supply can sometimes be utilized more effectively with a small capacity pump and a large storage tank. With this arrangement the well may be able to supply the small pump over a long period of time while the large storage tank is being filled. The large storage tank together with the output of the pump may satisfactorily carry over the peak demand periods.

In case of failure of the above methods, the most practical solution is to supplement the deep well with some other source. A common method in regions of plentiful rainfall is to provide a large cistern at the house or barn or both, where the larger roofs will catch enough water to keep the cisterns supplied.

As cistern water is soft water and desirable for washing purposes, the cistern usually supplies water for the hot water side of the plumbing system or possibly for all household purposes except for drinking.

Where a cistern or shallow well is used as a supplement for a deep well, two pumps will be required as a deep well pump will not pump from two sources and shallow well equipment will not pump from a deep well.

Cisterns

Where satisfactory ground water is not easily available and cisterns provide the most practical

source of supply, increasing the supply calls for enlarging the existing cistern or building additional ones. It is better, where possible, to build an additional cistern at another building to take advantage of additional roof area for collecting rain water.

Where cistern water is used for all purposes, the underground cistern is best because the water can be kept at moderate temperatures the year around. For best results roof water should not be turned into the cistern until after the roof has been washed off. The cold spring and fall rains provide the best water. A charcoal filter on the down spouts will help clarify the water. The cistern should be well sealed at the top to prevent the entrance of surface water.

Where cisterns must be depended upon for the entire water supply and there are periods of drought, the cistern should be a storage reservoir of ample size to carry through the dry spells.

Disking in Phosphate

PHOSPHATE fertilizers should be disked into the surface soil layer for best results on timothy, red clover and alfalfa stands, according to tests made at the Connecticut Experiment Station.

Recognizing that the phosphorus in soluble phosphates is fixed by the soil very close to the place of application, the Connecticut workers tried disking and harrowing in superphosphate, as compared with merely distributing the fertilizer over the ground surface.

In the case of Kentucky blue grass the effect on yield was about the same from one treatment as from another. In the case of orchard grass and timothy with red clover, however, the disked-in phosphate gave a 24 per cent greater increase in yield over that which was surface spread. With alfalfa and timothy, the increase in favor of mixing soil with fertilizer was 32 per cent.

How to Reduce Farm Accidents

Condensed from Pacific Rural Press

C. G. Chipchase

Engineer, Industrial Accident Commission

IT is only very recently that even the more progressive farmers and ranchmen of the country have begun to consider their accident problem and to make serious effort to reduce the number of men who are injured in farm accidents. The Farm Industry as a whole has lagged behind other industries in safety work, but at present, effort is being made to arouse farmers' attention generally to the enormous losses that accidents are causing them; and to point out that since other industries have been able to make great savings through organized safety work, farm industry can do the same.

In California, in the five year period from 1932 to 1936, inclusive, 253 farm employees were killed and 54,095 were disabled, for longer or shorter periods, by farm accidents. These figures do not include men running their own farms; all these men are, or were, hired hands. There is no way to determine the actual cost of these accidents, but a conservative estimate places the annual cost of farm accidents in California at not less than $10,000,000.

It is important to understand here that compensation and medical care of injured men accounts for only a small fraction of this cost. A study of 10,000 cases, made by an insurance company has shown that the so-called hidden cost of accidents, that is, the loss of time and material, damage to equipment and so on, amounts to four times the cost of compensation and medical service.

Railroads have reduced their injuries 83 per cent in the last ten years, Arthur Young, steel company executive, has stated that safety work has prevented 700,000 disabling injuries to men in their plants and has saved the company $92,000,000 net in the last thirty years. And their injury rate is still being cut every year.

Such figures show what can be done; the present question is how to set about getting similar results for farm industries.

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In the first place, farm industry is clearly a case where self-help is essential. With around 150,000 farms in California, it is impossible for any governmental agency to do more than point the way.

The most frequent, and the most costly injuries are due to falls. About 21 per cent of all injuries on the Pacific Coast farms comes from falls. Large numbers of men have been injured in falls from haystacks, from scaffolds and roofs while doing carpentry work, on slippery floors or stairs, through floor openings that had no railings, and from trucks or wagons.

Most of these causes need only to be pointed out to suggest their own remedies. Set ladders up firmly and don't allow men to try to reach too far from them; build scaffolds firmly; put railings wherever men could possibly fall. Danger spots are sometimes passed over with the thought: "This really isn't dangerous; no one has any business here," but men do get where they have no business, and they do get hurt there.

A good many farm employees are hurt jumping down from high places. This is a practice which is not tolerated in other industries, and should not be on farms.

About 20 per cent of farm injuries occur in handling objects, principally strains from lifting. Teaching men how to lift properly will eliminate most of these. Keep your back straight when you lift; make your leg muscles take the load.

Farm animals and farm machinery cause about the same number of accidents. Each accounts for about 10 per cent of the total number. Most of the animal accidents happen around barns, stables and dairies, and are due to startling the animals. Inexperienced men should not be allowed to handle animals without supervision. When saddle horses are used, it is important to keep equipment in good condition, and see that it is put on the animal properly. Injuries from poor or badly adjusted saddlery are usually very severe.

It is probable that farm machinery accidents are on the increase, rather than the reverse, as the farm is becoming more mechanized all the time. The greatest individual source of injury in connection with farm machinery is the operation of cranking a tractor. Be sure you grasp the crank with your thumb behind, not over the crank, and pull up, using your leg muscles, not your back muscles to give you power. And be sure your men do the same. Care is necessary in handling tractors, trucks and all automotive equipment. There are frequent serious injuries and even fatalities due to

men falling or being thrown from tractors and trucks.

There is always danger of being pulled into machinery if proper precautions are not taken. All pulleys, belts, chains, sprockets, gears and shafts should be guarded from contact. A revolving shaft is not safe just because it is smooth; many injuries are reported every year due to men's clothing winding up on smooth shafting and pulling them into machines. Loose clothing should not be worn around machinery under any circumstances. Manufacturing industries have learned these lessons; and have learned that the money spent to safeguard equipment comes back many fold.

Another bad spot in the record of the farming industry is the number of serious cases arising from neglect of small injuries. It is of high importance that no injury be neglected. Of course, most farms are not close to doctors or hospitals, but every farm should have at least one man trained in first aid, who can care for small injuries, give artificial respiration if necessary and take charge of serious injuries until a doctor can be obtained. A small first aid kit, if faithfully used, will prevent infection of most wounds, but if any sign of infection does develop, send the man to a doctor immediately. All other industries insist on all these precautions and the farm industry must learn to do likewise.

There is still another class of accidents to which farms are peculiarly subject, owing to the fact that on farms, men are often called upon to do things they have never done before and to face situations of which they have no knowledge or experience. For example, three men on a farm in the southern part of the state were recently moving a deep well pump for overhauling. One length of pipe fell to the bottom of the well and one of the men went down after it. He put his foot in a loop on a rope, and held onto the rope while the other two men let him down. But apparently the air in the well was bad; half way down the man lost consciousness, fell and was killed. Obviously, it did not occur to any of the men that the air might be bad.

In cases like this, when unknown conditions are faced, the only possible preventative is forethought. Men must learn to ask themselves "what could happen here?" and must guard against all possibilities. No so-called "improbability" can be dismissed, for, in such a situation men are not likely to have the experience to judge probabilities. In the above case, all that was needed was a safety belt tied to the rope. If this had been provided, the men could have pulled

him out, no matter what happened to him.

Eye injuries are likely to occur in many farm activities. Goggles should be worn when sharpening tools, breaking rock, doing maintenance and repair work or pouring babbit. When picking fruit or pruning trees, men should wear goggles to protect their eyes from swinging branches. In spray work, fume tight goggles should be used as many sprays are very injurious to the eyes.

Farm fires are one of the greatest causes of loss both of life and property. It is estimated that 3,500 lives and $100,000,000 in property are destroyed annually by farm fires in the United States. Defective flues and chimneys, especially in connection with combustible roofs are the cause of many fires. Spontaneous combustion, due to improper storage, also starts many fires. Improperly cured hay is very apt to heat and catch fire while in storage. Carelessness with matches is a factor in farm fires as it is in all fires.

Nowadays, butane and other liquified petroleum gases must be considered as a hazard along with gasolene and kerosene. The great explosive power of gasolene is often under estimated. Even in small quantities, it should be stored outdoors and well away from buildings. It should never be used at home for cleaning clothes, or to start or revive fires. Kerosene does not ignite quite so easily as gasolene, but large quantities should not be kept in buildings, and, if small quantities are kept indoors, they should be kept away from all sources of heat, or dangerously explosive vapors will be formed.

Defective or improper electric wiring causes its share of fires. All wiring should be done by competent electrical contractors, in accordance with the standards of the National Electric Code. Extension cords should be of a type approved by the Underwriters' Laboratories and should not be used as a substitute for adequate permanent wiring. Never run them under rugs, over doorjambs, or near radiators or steam pipes.

Several men have been killed or injured in California by bringing hand tools, pieces of pipe, lengths of well casing and similar objects in contact with overhead wires.

These are only a few points and this catalog of sources of injury could be expanded many fold. But the conclusion would still be the same: farm accidents can be reduced, but this can be done only by the farmers themselves.

Winter Care of Manure

Condensed from The Indiana Farmer's Guide

FARM management figures indicate that in the Corn Belt a difference in the yield of 10 bushels of corn an acre is responsible for a difference of from $500 to $700 in the net income. This takes into consideration the increase above the market value which is received on many farms by feeding corn to live stock and probably also holds true for other farming areas with corresponding figures for differences in yield of other major crops.

This difference in yield can be often accounted for by a few important soil management practices such as the daily or frequent hauling out and spreading of manure and proper crop rotation. By returning manure to the soil and the growing of legumes either for hay or pasture the problem of maintaining the fertility of the soil is simplified and crop yields are correspondingly increased. Organic matter is not only the life of the soil, holding moisture and food elements which nourish the crop, but also has a close relation to the cost of production in tillage and harvesting.

Tests at Ohio, averaged for five seasons, show that manure exposed in flat piles in open yards from January to April lost 36.5 per cent of the original nitrogen content, 22.5 per cent of the phosphorus content and 51 per cent of the potash, or altogether about one-third of its fertilizing value. Hauling out every day makes it possible to take care of the manure with but one handling. The labor saved by this method in larger dairies is of considerable importance when it is remembered that 25 cows, when stabled, will produce nearly a ton of manure each day, depending upon how heavily they are bedded.

The practice of top-dressing meadows and pastures makes it possible to use the manure spreader at all seasons and at the same time obtain maximum crop production. Alfalfa and other meadows may be top-dressed during the winter as well as corn or other cultivated crop land, while in summer the pasture will benefit from a light application.

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How to Grow Bush Fruits

Condensed from Better Homes and Gardens

George L. Slate

New York State Fruit-Testing Association

Delicious raspberries, blackberries, dewberries, currants, and gooseberries may be raised in your own home garden.

Bush fruits occupy little space, require no expensive equipment, little or no spraying, and will produce abundantly for nearly two months. To get this result all you need is the desire to grow them, a suitable site, and a knowledge of their cultural requirements.

The ideal soil is a fine deep sandy loam, well supplied with humus and retentive of moisture. Berries may be grown successfully on lighter and heavier types if they're well supplied with humus. Clay loams are best for currants and gooseberries. These fruits also tolerate some shade and may well utilize the north side of a building or fence that's too shady for bramble fruits.

None of the berries will tolerate "wet feet" and at no time during the growing season should the water table come within 3 feet of the surface of the soil for more than a few days. Poor drainage causes late autumn growth and consequent winter-killing. A saturated soil during the growing season will kill the plants outright.

All berries revel in organic matter. Its presence is indicated by a loose, spongy texture of the soil and its absence by a stiff, hard soil that bakes easily and is subject to drouth. If the soil isn't well supplied with this material the deficiency should be remedied in advance of planting by liberal applications of manure, or lacking that, of peat-moss. In larger plantings rye, buckwheat, or clover may be grown and turned under to provide organic matter.

Such pernicious perennial weeds as quack grass and bindweed must be eliminated before the berries are set. Weeds prevent good air circulation, without which such fungus diseases as anthracnose of black raspberries and mildew of gooseberries may set in.

Black raspberries frequently fail in the garden. But you

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needn't fail if you follow these rules: Don't plant black raspberries near other raspberries that are known to harbor the virus diseases that trouble this group of plants. Varieties which are particularly dangerous to black raspberries are Latham and Ranere red raspberries and the Columbian purple raspberry. See that these raspberries aren't growing within 100 yards of your other raspberries. Old run-out patches of berries should also be removed before the new stock is set. Another source of grief is a wilt disease that's brought into the garden by such crops as potatoes, tomatoes, peppers, and eggplants. To avoid trouble with this disease which lives in the soil, don't plant raspberries on land that has produced these crops during the previous 3 years.

The best source of bush-fruit plants is a nursery specializing in small fruits in a state that requires that raspberry fields be certified as nearly free from mosaic before plants may be sold from them. General nurseries and seedhouses sometimes maintain good small-fruit departments. Avoid gift plants from a neighbor's garden unless they're known to be disease free. Order early while the nurseries still have all varieties in stock.

Thorough fitting of the soil is essential to a good start. Plow or spade the soil 8 to 10 inches deep the previous fall or as early in the spring as the ground can be worked. After thorough surface cultivating, the bed is ready for planting. Bush fruits start growth early and should be in the ground as soon as possible. Late-spring planting, if followed by dry weather, will cause the loss of many plants. Fall planting, when possible, is to be preferred.

As soon as the plants come from the nursery, open the parcel. If you're not ready to set them, heel them in in a moist shady place by digging a shallow trench and setting the plants in it with moist soil packed tightly among and around the roots. If the plants are dry on arrival, soak them in water for several hours to revive them. While setting the plants, immerse the roots in a pail of soft mud until you're ready to place them in the ground. Don't permit them to dry out at anytime.

To set gooseberries and currants, dig a hole slightly larger than necessary to accommodate the roots, set the plant slightly deeper than it stood in the nursery (see the soil marks on the stems) packing the soil firmly against the roots to leave no air spaces. Brambles may be set by plunging a spade vertically in the soil to its full depth, pulling it forward, inserting the plant in the hole, removing the spade, and then stepping heavily on the soil

near the plant to press it firmly about the roots. At this time cut back red raspberry and blackberry plants to 6 inches and remove the old cane entirely from black and purple raspberries because it may infect the new shoots with anthracnose fungus. The tops of currants and gooseberries should be cut back to 6 inches at planting time. Plant foods aren't needed when the plants are set and probably not for the first year.

Plant currants and gooseberries about 5 feet apart each way, red raspberries and blackberries 2 feet in the row, and 6 or 7 feet between rows. Black and purple varieties need about 3 or 4 feet between plants in rows 6 or 7 feet apart. These varieties are often grown in hills, but the narrow hedge row, in which the sucker plants are allowed to fill in the row to a width of one foot, is easier to manage and will produce more fruit.

Cultivation should be shallow, not over 4 inches deep and sufficient to keep down weeds. In established plantings mulching is the ideal system of soil management if a suitable material is available at a reasonable cost. Mulching keeps down weeds, prevents soil from splashing on the berries during heavy rains, and in dry seasons may conserve moisture sufficiently to double the yield. Marsh hay, straw, and rain-damaged hay or forest leaves are suitable mulching materials. During the first two years the mulch is on the planting, feed liberally with a nitrogen plant food to compensate for the nitrogen required by soil organisms which are rotting the mulch.

Bush fruits need a lot of plant food. You can use stable manure, a pound or more to the square foot, but most people will find it more convenient to use a balanced plant food, if there's humus in the soil, at the rate of 1 pound, plus 1 pound of nitrate of soda or sulphate of ammonia, to 100 square feet.

To prune correctly, you need to know how the plants grow. The canes of brambles are biennial—that is, they make their growth one season, bear fruit the second year, and then die. The root system lives indefinitely, sending up new shoots each year. From this it follows that as soon as the canes have produced a crop of berries they're of no further use to the plant and should be removed.

In early spring, before growth starts, cut back the canes of red raspberries about one-fourth, remove the weaker canes, and thin the remaining canes to stand about 6 inches apart. Black and purple raspberries have branched canes. Cut the branches on black raspberries back to 4 to 6 inches, but leave the branches on purple

raspberries about 12 inches long. Leave blackberry laterals 18 inches long. Tie dewberries to stakes 5 feet long, the canes being cut off at the top of the stake or tied to a single wire trellis 3 feet high.

New shoots of the black and purple raspberries and blackberries, if allowed to grow unchecked, make long sprawling canes difficult to manage. To overcome this tendency those of black raspberries are pinched off 18 to 24 inches from the ground and purple raspberries and blackberries 6 inches higher. Removing the tip of the shoot checks its upward growth, branches develop, and a sturdy, compact, self-supporting bush is produced.

Pruning currants and gooseberries consists of removing all canes over 3 years old as well as short, weak canes, leaving 6 to 8 strong shoots. With varieties having a sprawling habit of growth cut out the prostrate canes, while the upright sorts should be opened up in the center to facilitate picking.

You'll get your greatest pleasure from small fruits through the opportunity you have to grow the choice fine-quality varieties not always available on the market. The varieties suggested include the high-quality sorts as well as the old standards of known reliability, and some of the more promising newer sorts.

Latham and Chief are both widely grown and popular red raspberries and are adapted to a wider range of climate than other good sorts. They're for people who are satisfied with just raspberries. They'll bear regularly heavy crops of fair quality fruit. The highest standard of quality is still the old Cuthbert variety, but it has its faults. Viking, for the northern states, is of excellent quality and otherwise desirable. Newburgh is very large and rarely troubled by mosaic, but only fair in quality. Very new, and promising to be superior to the preceding, are Taylor and Marcy. Both are distinctive in appearance, with their long conic shape. Marcy is the largest of all red raspberries. Ranere (St. Regis) will endure the heat south of Washington, D. C., better than others, and Van Fleet will grow in the southern states where it's too hot for other red raspberries. A fine new autumn fruiting, or so-called everbearing, variety for the northern states is Indian Summer.

Black raspberries are prized for their sweet rich flavor. Plum Farmer is the standard early sort. Cumberland, ripening a week later, is of superior quality. Newer and finer varieties are Bristol, Dundee, and Naples, which ripen in that order. The first two are unequaled in quality; the last is good.

Purple raspberries are excellent for canning and jam and bear very heavy crops. Potomac and Sodus are the best available, the latter being somewhat larger and of better quality in New York state where this class of raspberry is chiefly grown.

Eldorado is easily the best blackberry in the north, with Snyder suggested for the colder northern areas. In the milder parts of the country Himalaya, Evergreen, and the new Brainard are fine for home use.

Dewberries are doubtfully hardy and need protection in the northern states, but a fully ripe specimen of Lucretia is a delicious morsel. The Youngberry, a very fine flavored trailing blackberry, is worth a place in any garden on the Pacific Coast or south of the Ohio river. The most recent candidate for favor in this class for the same region is the Boysenberry, even larger and of fine flavor.

Currants are much neglected in home gardens, but there's no finer jelly fruit than the red currant, and its juice is most refreshing for summer drinks. Wilder and Perfection are standard and reliable varieties. Perfection has especially large berries and clusters, but is a weak, sprawling, short-lived bush. Equally desirable in fruit character and much superior in plant character is the new Red Lake variety. White Grape is a satisfactory white-fruited variety.

Gooseberries are very infrequent in gardens now, but green-gooseberry sauce and green-gooseberry pie are as delicious and healthful as they ever were. The new larger-fruited varieties are much easier to pick than the old-fashioned small-fruited sorts. Red-fruited Poorman gooseberry is my favorite and the only variety that I like to eat out of hand as a dessert fruit. Chautauqua is a very large green variety and Fredonia a very large red sort. The older Josselyn and Downing are still worth growing, although smaller fruited.

Alfalfa as Green Manure

Condensed from The Michigan Farmer

R. L. Cook

PLOW your alfalfa under! The livestock feeder will throw up his hands in horror at this statement, but the practice should be followed whenever it is economically possible.

Under the proper management, alfalfa is unexcelled as a soil-building crop. There are certain precautions, however, which should be considered lest attempts at soil building through the production of this crop actually result in soil depletion. Where the seed is inoculated with the proper bacteria, alfalfa takes two-thirds of its nitrogen from the air and one-third from the soil; but, since two-thirds of the nitrogen in the mature alfalfa plant is contained in the tops and one-third in the roots, no nitrogen is added to the soil when all of the tops are removed, unless the hay is fed to livestock and the manure is returned to the field. Furthermore, the phosphoric acid and potash is all taken from the soil. The continued production of alfalfa hay rapidly depletes the soil of these plant foods.

At this time of the year, many old alfalfa fields are being plowed. In many cases, the third crop has attained sufficient growth to make a good cutting of fine quality hay. Many farmers will remove the hay before plowing the field. If hay is plentiful and the sale price is low, it is a good time to build up the soil by turning this third crop under. This also eliminates the necessity of curing hay during the late fall months when days are short and temperatures are low.

A ton of dry alfalfa contains 49 pounds of nitrogen, 10 pounds of phosphoric acid, 42 pounds of potash, and contains enough calcium and magnesium to be equivalent to 100 pounds of limestone. At current fertilizer prices, it would cost $7.87 to replace these materials in the form of commercial fertilizer. It is true that if the seed was inoculated the nitrogen did not all come from the soil; but where the hay is sold, the soil is being deprived of the full quantity of nutrients contained in the hay removed. It would seem, then, that unless the third cutting is needed for feed, it should be plowed under rather than be harvested for hay. Alfalfa hay should only be harvest-

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ed for sale purposes when the price is great enough to pay a cash return above the cost of harvesting and marketing plus the value of the nutrients as fertilizer materials.

In Tuscola County during the past season, a certain 10-acre field of alfalfa, both cuttings, was sold for $60. The total yield was probably in the neighborhood of 30 tons of dry hay. Actually $236.10 worth of plant nutrients were sold for $60. This does not take into consideration the value of the organic matter in which the nutrients were contained. Experimental results have indicated that when green manure crops are plowed under the organic matter itself may be fully as valuable as the actual plant foods contained in the green tissues.

Surplus feeds should never be sold from the farm unless the price received is more than the plant food would be worth if it were in the form of commercial fertilizer!

Progress in the Science of Poultry Feeding

Condensed from The Rural New-Yorker

C. E. Lee

MORE progress has been made in the actual science of poultry feeding in the last 15 years than in the preceding 1,500 years! That is a strong statement and some may question it, but the matter is easily settled, "Let us look at the record."

Prior to the late 1700's nobody seems to have attempted to do much toward feeding chickens a balanced ration. About that time Remarque, French philosopher and agriculturist, published a book (of which one of the two or three copies existing in North America may be found in the Cornell University Library) in which he described his investigations into incubation and other poultry arts carried on by the Egyptians and also investigations he had made in France and certain experiments which included some experiments in feeding laying hens.

Noticing that hens laid better in the Spring when they got an abundance of worms and other insects and green grass, Remarque attempted to get high egg production in the winter by providing some of the same things that the hens would normally get in the spring. He raised worms

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in barrels of earth and fed these to the hens during the winter and also gave them leafy leguminous hay to pick at.

His experiments may have caused some comment at the time, but apparently they dropped out of sight for over a hundred years and most people went on keeping chickens in small farm flocks where they acted as general scavengers. Hens and pigs were thought of as a means of turning waste products into human food which could be sold for cash or traded for supplies.

No one had yet attempted to find out much about the requirements of the hen in a nutritive sense. Wheeler at the Geneva, N. Y., Station, did some of the earliest work on rations from a standpoint of chemical analysis. This and some other investigations ushered in the period of evaluation of the poultry ration on the basis of the chemical analysis.

THE CHEMICAL ANALYSIS PERIOD.—It is only necessary to go back to textbooks published around 1910 and up to the early 1920's to note that the great emphasis was placed on "nutritive ratio." This was simply the proportion of protein to carbohydrates and fat. There were great arguments over whether the laying hen should have a nutritive ratio of one to three, one to three and one-half, or one to four, or some other proportion. Similar debates went on in regard to the proper nutritive ratio for baby chicks, growing hens and poultry of other ages or types.

It was generally admitted that milk was somewhat superior to most other foods, and some had a feeling that animal proteins as a whole were better than vegetable proteins, but nobody could prove very much about it or had any idea of the fundamental nutritive differences.

Many poultrymen bought rations purely on a chemical analysis. If two rations were offered, one 18-percent protein and the other one 20-percent and both were the same price, or nearly the same, it was assumed that the 20-percent ration would be the more profitable purchase. Little was known and practically no consideration given as to the types and qualities of materials used or the proportions in which various materials were combined. Differences in availability of the proteins, carbohydrates, or fats in the different materials were given practically no consideration and no attention was paid to vitamins because most of them had not yet been discovered and no extensive application to poultry feeding had yet been made.

Experienced poultrymen started most of their chicks about April 1 over the greater part of the Northeastern States, because

chicks started at that time could be out on the grass at just about the time the grass began to turn green and the sunshine became warm enough so that the poultryman felt safe to let the chicks range. It was a commonly accepted belief that chicks derived some strength from running on the ground that could not be gotten otherwise, and it was not until some years later that it was definitely proven that the big factor was the sun shining down on the chicks that made the difference and not the ground underneath them.

A little later, particularly during the 1920's, evidence began to accumulate to show that a 60-percent protein product made up by grinding up old shoes or something similar was hardly the same thing as 60-percent protein or even half that amount from some good source like beef, or milk, or fish. Similarly, it began to be recognized that there is a difference in nutritive value in all sorts of feeds and between different qualities of the same type of feed, and that oftentimes these differences are out of all proportion to the differences in chemical analysis. We began to find also that feeds made up in different combinations gave entirely different results even though the chemical analysis of one combination was the same as that of another.

Evaluation by Feeding Tests.—The biological efficiency of any feed or of any combination of feeds was given a rating on the basis of an actual feeding test on the particular type or age of poultry to which it was to be fed.

It began to be generally recognized that nobody could definitely determine the feeding value of any feed material or any combination of feed materials except by an actual test. It was definitely proven that two feeds could be tested separately and given definite ratings on poultry and yet when these two feeds were combined the nutritive value of the combination might be three or a dozen times the demonstrable nutritive value of the separate ingredients when fed alone.

The discovery of vitamins and their application to poultry feeding furnished the key to unlock some of these puzzles.

The Vitamins.—Although the discovery of the cure of vitamin deficiency diseases (avitaminosis) goes at least as far back in history as 1720 when Dr. Kramer, an Austrian army surgeon, used lime or orange juice as a cure for scurvy, and in 1757 was established experimentally by work on sailors of the British Navy by a Captain Lind, it was not until 1912 that two Norwegian scientists, Holst and Frolich, established that such diseases as scurvy and beri-beri were due to a de-

ficiency of extremely small amounts of certain substances in the ration.

It was really not until the 1920's that we began to be seriously concerned with vitamins in the poultry rations, and the period since then, and up to and including the present, might perhaps be called the "vitamin period" in the formulation and evaluation of poultry rations.

At times it almost seems as if we had lost sight of the chemical analysis, and particularly of the variations in value of various proteins, carbohydrates and fat, and of such factors as palatability, laxative effect, or costive effect, fiber content, etc., in the poultry ration, so obsessed are we with study of vitamins.

For many years vitamins were often referred to as "those mysterious substances which cannot be seen but which have an extremely important part in nutrition." There is nothing particularly mysterious about vitamins any more, except that we have not yet been able to work out the exact chemical formula for every one, but that is just a matter of time. We now know that each vitamin has a definite chemical composition and gradually scientists are learning how to extract and identify the different chemical substances which we call vitamins and to produce them artificially.

It is perfectly possible to buy many of these vitamins now in concentrated form. For example, you can purchase for laboratory use, a concentrated solution of vitamin D that would contain as much of this vitamin in a thimbleful as could be got out of several barrels of cod-liver oil. Vitamin A (anti-opthalmic), which is concerned with eye and other local infections caused by the drying up of secretions from tear, salivary, and intestinal glands, is now known to be polyene alcohol. B-2, more commonly known in this country as vitamin G, may now be split up into probably some seven different factors of which some cause poor growth and others cause sores on the corners of the mouth, sticking of eyelids, or ragged feathers, cracks in the feet, and another a type of paralysis, and another probably the main factor in definite intestinal control, etc. Flavin, now officially called Ribo-flavin, is the one which is usually referred to when people say "vitamin G," but this will soon change for Ribo-flavin is only one factor or one vitamin and there are a number of other factors which must be accounted for in the vitamin G complex.

Vitamin C which is so important in human nutrition, but which is formed by the chicken in its own system, and therefore does not need to be present in

the poultry ration, is Ascorbic acid, while vitamin B-1 is built on a Pyrimidine base and carries sulphur. Vitamin D is supposed to be a sterol, while vitamin E is an alcohol, and vitamin F is composed of the fatty acids Linoleic and Linolenic.

It should be added that vitamin D is a complex with probably seven to nine different factors instead of being a single vitamin as has been supposed for a number of years. It has been demonstrated that laboratory rats need certain factors in the vitamin D complex for good calcification, while poultry require additional factors, and that is the reason why some so-called vitamin D substances give excellent results with rats and do not give satisfactory results at all with chickens.

Measuring Vitamins in Feedstuffs.—Formerly, it was necessary to carry out long biological experiments with chicks or with rats to determine how much of any vitamin might be present in a given ration or a given feedstuff. Gradually, as the chemical structure and identity of each vitamin becomes known, it will be possible to develop a process of laboratory extraction so that we may measure the amount present in any ration or any substance after a few hours laboratory work on the the material.

We now know definitely the units of vitamins A, D and G (complex) required by poultry, and the approximate or exact amount contained by different feedstuffs we may use in the ration. Although the extra cost of these vitamins raises the level of our feed prices per ton, still the results from their use may often make the difference between success or failure.

Laboratory extraction processes have been developed for certain vitamins, particularly provitamin A (in the form of beta-carotene), and the most progressive manufacturers of high-quality feeds now analyze every carload of Alfalfa leaf meal and other carotene containing feed materials to be sure that the vitamin A content is up to standard, before the material is actually used in the feed.

However, it will be a number of years before laboratory tests will have been perfected to cover all of the necessary vitamins so, for the present, a combination of laboratory extraction and research farm or laboratory tests with live birds will have to be used.

History of Hay Making (Part II)

Condensed from the Jersey Bulletin

Professor Oscar Erf

Ohio State University

IN the past, good and poor hay was a matter of opinion, regardless of what the real facts were. What one man might call good hay, another man might call poor hay. So there has been a constant tendency and demand for some process of standardization. Accordingly, the National Dehydrating Association was organized in the spring of 1937 for the purpose of formulating laws which in the future might be adopted by the legislature. Hay that has in it the proteins which oftentimes run as high as 24 per cent, is of the most desirable kind. Hay which has in it considerable dextrose, which is of course the most easily digested carbohydrate, is also desirable. The reasonably high per cent of fats, the extraordinarily large mineral content, the high carotin or vitamin A, which have to do with fertility, protection, growth, etc., the high vitamin G, which has to do with growth and development, and the large amount of vitamin K, which has to do with the normal coagulation of the blood, are all good factors.

The mineral content, if grown on rich soil, is usually the most valuable and most complete in these young dehydrated hays, and is practically the only way in which these minerals can efficiently be metabolized in a balanced form.

We have but few standards that guide us in knowing whether a hay is of a desirable character. In the first place, the percentage of protein in dehydrated alfalfa hay should never be less than 17 per cent and preferably 22 per cent. The minerals should be at least 8½ per cent, and preferably from 10 per cent to 11 per cent. The carotin content we prefer to have is a minimum of 10 milligrams, and a cow should have 8 pounds of this hay a day, which is the minumim for developing a properly developed calf during the fetal stage, and preferably 18 milligrams. Ordinary green hay on a water content basis usually runs at a high point of 9 milligrams in the spring. Most of the hay in the spring of 1937 had about three-fourths of a milligram per 100 cc. on a dry basis.

There might be times when ordinary sun-cured hay with a maximum of 6 or 7 milligrams, if an abundance is fed, would be

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able to maintain the proper fertility, providing the cow would have at least a week or two of pasturing. Of course, in alfalfa leaf meals it may run as high as 37 to 38 milligrams. Under these conditions, a few pounds of this kind of hay mixed in the grain ration would provide a sufficient amount of carotin, providing the field cured hays have at least 2 to 4 milligrams of carotin, and providing it is fed in abundance.

Cows do have a habit of picking out the choice particles of hay, leaving behind the rough stemmy material which contains little or no carotin. Some of our analyses have shown that the protein of the minute buds on the top of the plant have a protein content as high as 32.2 per cent. On analyzing the same plant inch by inch, there was a gradual decline to the last inch above the ground of seven-tenths of 1 per cent of protein. The mineral content of the bud was as high as 15 per cent, and graded down to .12 per cent.

Therefore, the cow usually gets a higher percentage if an abundance is fed of these important constituents, if she has the privilege to select, than the average obtained from chemical analysis. The buds have, besides the vitamin content, some alkaloids which are of great importance.

It must not be forgotten that an alkaloid known as betain obtained from well grown beets is a highly important, but not absolutely necessary, factor in fertility, when cows are stabled the greater part of the year. It is a highly important stimulant.

We find, therefore, that to maintain the nutrients in the original hay, it is necessary to resort to two methods, as we understand them now. One is, by means of rapid dehydration of the green hay in the presence of non-oxidizing gases. The other is, by packing it in air-tight receivers or silos with some non-oxidizing gas, and for that reason we have found that dry ice which cools the green hay, and cooling the hay forms a non-oxidizing gas, is a desirable method, largely because it leaves the hay very palatable and because of the cooling, in the beginning, acts as a great preservative to the fertility factor. So far, we have found no method of making hay from the green state to the dry state by air drying, which will retain a sufficient amount of the fertility factor, except possibly that made in the irrigated regions, and where drying is rapid and the hay is immediately baled.

We do not want to leave the impression that good green field-cured hay is not a valuable feed for the average farmer, even for high producing cows. For good pasture during the spring and

summer, or a good soil crop system accompanied by a system of feeding in which field-cured hay is fed, supplies a sufficient amount of the fertility factor to develop a normal calf. Where cows are fed in stalls during the entire year, hay with a high fertility factor is therefore necessary.

Mechanics

The mechanics of making hay, therefore, becomes a very important factor. Because hay grows at a certain rate of rapidity, the machine that dries the hay must be of a certain capacity, and this capacity is usually too large for the average farmer. Therefore, it has become impracticable to expect a farmer to buy a dehydrating outfit. This must now be left in the hands of men who have capital, or else cooperative associations, to dry the hay of the community and to properly grow it.

Proper growing can easily be left in the hands of the individual farmer, providing it can be quickly delivered to the drier. Hence, a drier can easily supply a community of from 70 to 80 miles in circumference. From our experience, the smallest drier could accommodate about 200 acres of alfalfa hay. It might crowd it during the first cutting, but a larger acreage and a larger drier have greater possibilities of being more profitable.

But when one considers the great saving of nutrients which is being accomplished by proper drying, it is very easy to see the great value of dehydrated hay compared with the sun-cured hay. All of this scientific work seemed to be necessary to be the forerunner of hay drying operations.

Most men who have had experience along this line, consider the value of a ton of dehydrated hay, which has been properly handled, to be about three times the value of a good sun-cured hay, from the standpoint of the fertility factor, not taking into consideration the many other improved factors. Ordinary hays range from 6 to 7 milligrams of carotin, while dehydrated hay has 20 milligrams. This, of course, takes into consideration only the beta carotin.

There are now two types of successful driers on the market—one which is a low temperature drier, the other a high temperature drier.

It must be borne in mind that the low temperature drier may dry in sections at temperatures as high as 300° to 400°, but it must only remain at that temperature long enough to evaporate the greatest percentage of water and keep the hay cooled by evaporation, which we find is usually about 150°. It must then be finished completely at a tempera-

ture of 180°. The maximum that beta carotin will stand is 240° temperature for five minutes.

The more recent developments which take a smaller machine, are the high temperature driers, in which 1,000° to 1,200° of temperature are used, but this is only applied for a minute and a quarter, after which it must be immediately cooled.

Hay at these temperatures going through the driers, should never reach a temperature of much more than 180°, if the driers are properly operated and properly controlled by thermostats.

While all of these driers made at the present time require considerable capital, as time goes on improvements will be made and the cost will be reduced.

Of course while this method of operation of drying to preserve the nutrients in hay is practical for feeding all livestock, it has become practical to use this hay principally in the grain ration for dairy cows, for it supplies the vitamins A, G and K, which are not supplied in the grain proper to any great extent. It has become a very valuable mix in the grain rations to the extent of from 6 to 7 pounds per cow per day, providing the hay has a high carotin content. It has been a practical success, and we have used this method of feeding for over 12 years with success.

Due to the large investment required for these hay driers, repeated demands have come to us to find some cheaper method which could be used on the farm, and only on the farms where the hay is made. It is for this reason that some six years ago we made a great many attempts to keep this hay in silos.

In the beginning, we thought that just plain grass properly packed in a tight receiver was all that was necessary, but we lost a large amount of the nutrients during the summer months, particularly the fertility factors. In the fall months, hay can be put up in silos—say in September—and fed in November without much loss of carotin.

But the spring crop, which is the one that needs the most attention, cannot be handled that way practically, unless the receivers are insulated. We have found that lowering the temperature and holding the hay at 45° with a slight amount of carbon dioxide or nitrogen gases seems to work well.

In some of the southern countries, where sugar is cheap, the application of sugar in green stuff was tried in Florida and Cuba some 10 to 12 years ago. This helped out in the preservation of the grasses, but we still lost the fertility factor. Later molasses, which was very much cheaper, was used with success in some seasons.

After that, a large amount of this work was carried on at Randleigh Farm, Lockport, N. Y., where we preserved, and still are preserving, green grasses in various ways, in order to retain the fertility and growth-promoting factors.

Mr. A. J. Bookwalter, of Springfield, Ohio, was the first to build a large silo four years ago, which was gas tight, and where we preserved the green alfalfa hay with dry ice, which we had found on the Randleigh Farm to be the most practical way.

Mr. O. L. Inman, Director of Chlorophyll Research, at Antioch College, is undoubtedly the best posted man on chlorophylls and carotins. He has a very complete record of this experimental hay, which indicated that fertility factors can be held quite satisfactorily in this large container.

It must, however, be said that in the hay at the top of the silo the carotin is much lower than at the center or the bottom. It seems that the carotin has been apparently oxidized at the top of the silo. Possibly this is due to the dilution of the carbon dioxide with the air. Only small quantities of dry ice have been used in this case. Less than 50 pounds per ton have been applied. No mold was on the top of the silo, and the cattle relished it all the way down.

Recently, however, for small farmers, Mr. C. F. Michael, Bucyrus, Ohio, conceived the idea of packing the hay in barrels, since much of our work has been done in that way at Randleigh Farm. He therefore put up quite a number of barrels of hay, running the hay first through the hammer mill. It is easy to get from 200 to 250 pounds of hay in a barrel if it is coarsely ground. However, Mr. W. R. Kenan, owner of Randleigh Farm, found that, where it was especially hammered into a fine pulp so that it would pack properly without letting any air in, he was able to get 400 pounds of hay in a 50-gallon barrel.

On Randleigh Farm we have been using iron chemical barrels with a properly sealed lid, while at Mr. Michael's farm we have been using wood barrels, which can be purchased at a low price. These barrels can be purchased at less than half cost of building a silo of the same capacity.

Last year the hay at Mr. Michael's farm was packed in these barrels, part of them with dry ice and part of them with molasses. One group with the dry ice had 50 pounds per ton, the molasses had 150 pounds per ton, and part of the hay had 200 pounds per ton. In the past we have found that we could not hold carotin to any great extent with less than that much molasses.

On February 15th these barrels were opened, and there was sufficient hay in each barrel for two days' feeding for his herd of 18 cows. The hay was immediately taken to Antioch Laboratory and Dr. Inman analyzed the moist hay coming from the same batch and put up on the same day in the same way. He found the carotin content in the hay treated with the dry ice about 9.2 milligrams and 1.2 in the barrels where 150 pounds of molasses per ton of hay was used. In the dry hay, we had less than ½ milligram this year due to the heavy moisture content.

Molasses hay, if put into a tight tank, shows that twice the amount of carotin can be retained than in ordinary hay making. There are great possibilities in developing a method of preservation on the farms, but it must be recognized that a dehydrating machine under all conditions seems to be the most practical as yet.

Soil, Fertilizer Action, and Plant Nutrition

Condensed from The Fertilizer Review

Dr. Emil Truog

Professor of Soils, University of Wisconsin

VERY much more is known about soils today than was the case at the beginning of the present century. It is now possible to test a soil in a few minutes and tell what its lime and fertilizer needs may be for the growing of certain crops. During the month of April of this year, 2,800 samples of soil and limestone were tested in the Soils Laboratory at the University of Wisconsin. Other equally striking examples might be cited. The time is near when the supply of nutrients and conditions for plant growth in soils will be controlled by means of tests, much as similar matters are controlled in a chemical factory. Not only in soil testing, but in the whole field of soil science, has much progress been made. Particularly in the last 25 years have many notable advances been made relative to soil morphology, soil composition, soil colloids, interaction of soil minerals with fertilizer constituents, methods of fertilizer application, the role of the minor elements, soil testing, and plant symptoms of nutrient deficiencies.

To the casual observer, soil is simply the loose or unconsolidated mineral and organic material which covers the face of the

earth in many places, and in some mysterious manner serves as a medium in which plants find support and sustenance. At the time the United States declared itself to be an independent nation (July 4, 1776), comparatively little more was known about the chemical constitution of soils, and the relation of this constitution to plant growth, than is expressed in this very general layman's definition of a soil.

Today, soil is looked upon, not simply as loose mineral and organic material covering the surface of the earth in many places, but rather as a distinct entity or body having a form or anatomy all its own. When soils are viewed in cross-section as is possible in a road-cut, or any excavation, it is found that they are made up of distinct layers which bear a close relationhip to one another. The form or anatomy of this cross-section, called the soil profile, constitutes the basis on which soils are classified and mapped today. The top layer of soil is usually the most fertile layer and the one best adapted for cultivation. When it is removed by erosion, the value of the land for crop production is greatly reduced and in many cases made worthless.

As a medium for crop production, soil may be looked upon as a factory in which there are shelves to store plant food and also machinery which makes this plant food available to the growing crop. For each pound of dry alfalfa hay produced, the soil must deliver to the alfalfa plant 700 pounds of water. To do this, the soil must hold and store the water that falls as rain, and then deliver it to the plant as needed. Besides water, soils must also supply the plant with at least ten nutrient elements, including nitrogen, phosphorus, and potassium. These nutrient elements, like water, must also be stored and delivered as needed. How does a soil do all of this? The answer involves too much physics, chemistry, and bacteriology to present in detail here. It may be illustrated in the following manner:

Plant nutrients, such as phosphorus and potassium, are held in the soil in two forms. There is the readily available form. This form is held in the very fine soil particles much like money in a checking account. Plants draw on this largely for their daily needs. Then there exists also a much larger portion which is difficultly available. This form is held in certain soil material like money invested in fixed or frozen assets. Plants draw on this for only a fraction of their daily needs. If forced to depend entirely on this form, crops make at best a poor and unprofitable yield. It is like

an individual trying to live entirely from the proceeds of frozen assets.

Soil testing by chemical means started about 125 years ago. In 1813, Sir Humphry Davy wrote (Elements of Agricultural Chemistry) as follows:

"If land be unproductive, and a system of ameliorating it is to be attempted, the sure method of obtaining the object is by determining the cause of its sterility, which must necessarily depend upon some defect in the constitution of the soil, which may be easily discovered by chemical analysis."

About 50 years later, Dr. August Voelcker wrote (Jour. Roy. Agr. Soc. V. (1865) as follows:

"There was a time when I thought, with many other young chemists, that soil analysis would do everything for the farmer, three or four years of further experience and hard study rather inclined me to side with those men who consider that they are of no practical utility whatever; and now, after 18 years of continued occupation with chemico-agricultural pursuits and, I trust, with more matured judgment, I have come to the conclusion that there is hardly any subject so full of practical interest to the farmer as that of the chemistry of soils,—the longer and more minutely soil investigations are carried on by competent men, the greater, I am convinced, will be their practical utility."

The cycle of experience of Voelcker relative to the practical value of soil analysis has been repeated over and over again by subsequent investigators. Unfortunately, many of these subsequent investigators stopped before completing the cycle, that is, they stopped at the first disillusionment. Practically all of the present day soil chemists who do not look upon soil testing with favor have never given the matter real serious study.

If soil testing was practicable in Davy's and Voelcker's time, it should be even more practical today for several reasons. In the first place, there is now a much better understanding relative to the forms in which plant nutrients exist in soils, the availability of these different forms to plants and how they may be extracted and determined. For example, it is known that the readily available potassium of soils exists in exchangeable form and can be extracted by treatment with a dilute acid or a salt solution. Secondly, chemical tests for detecting and determining the various essential elements have been greatly improved in recent years. Then too, more and more investigators are making an intensive study of the matter, a more acute need for tests has arisen, and finally the modern

age is demanding from soil science the same service it is getting in other fields.

As a result of these developments, agricultural experiment stations are providing service laboratories for soil testing on a large scale. Many agricultural teachers and county agents are making extensive use of rapid soil tests for determining the fertilizer needs of soils. Private laboratories are being set up for soil testing on a commercial basis. A number of fertilizer companies have provided central laboratories for soil testing, and many fertilizer salesmen are making use of the rapid soil tests in the field.

After the soil tests have been carefully and accurately made, there still remains the all-important matter of proper interpretation. Previous soil treatment, kind of crop to be grown, climate, and yield desired or economically practicable are all factors to be considered. Even after giving all the apparent factors due consideration, one is sometimes disappointed in the results obtained by fertilizing in accordance with the indications given by soil tests. That these disappointments are not always the fault of the soil tests is exemplified by the following experience.

A number of years ago, fertilizer and lime tests with alfalfa were conducted on about 15 fields scattered over the southern half of Wisconsin. Soil tests were made of the surface soil of all the fields, and treatments given accordingly. On all but three fields, the response to treatment was in line with the results of the soil tests. The soil tests of these three fields indicated a decided lack of lime and readily available phosphorus. The cuttings of alfalfa the first season indicated a fair response to lime and phosphate; the second season they indicated less; and the third season there was no response at all, even though the season was favorable and good yields throughout were obtained.

In casting about for an explanation of the results, it was decided to sample and test the subsoil to a depth of 60 inches. The results obtained afforded a perfect explanation of the situation. At a depth of about three feet, an abundance of readily available phosphorus was encountered, the acidity became less, and the supply of available potash increased. By the time of the third season's cuttings, the root system of the alfalfa had developed sufficiently in the deeper subsoil so that the additional needs of the plant for lime, phosphorus, and potassium were entirely supplied in the deep subsoil. It so happened that the conditions for starting alfalfa were very favorable the season the alfalfa was sown, and thus a good

catch was obtained even without treatment on these three fields. Had the season been less favorable, the results probably would have been different due to a poor stand on the untreated plats.

These results emphasize the desirability of carefully considering all the factors involved in the production of a good or poor yield on a certain soil before condemning the results of soil tests on this soil. It is with the deep rooted crops that the supply of nutrients in the deep subsoil assumes its greatest importance. Tests of the subsoil may thus suggest changes in the cropping system so as to take advantage of the reserves of nutrients sometimes found in the subsoil. In one case in Wisconsin, soil tests have revealed such large amounts of lime and readily available phosphorus in the deep subsoil that farmers are now bringing this subsoil to the surface to neutralize acidity and supply much needed phosphorus.

Aside from desirability of sampling the subsoil, it is still more important that many samples be taken from the surface soil (plowed layer) because of the great variation that usually exists in a field. It is advisable in many cases to take a separate sample from each acre. A map can then be made and lime and fertilizer applied accordingly. This prevents over-liming of certain portions and under-liming of others and a resulting uneven field. It is highly important from many standpoints to make the fertility of a field as uniform as possible.

Consumer Co-operation in Perspective

E. Johnston Coil,

Director, National Economic and Social Planning Assn.

EUROPEAN experience in the development of co-operative enterprise provides an instructive background for viewing the problems and policies of the co-operative movement in the United States. Many years of work have revealed to European co-operators certain principles which are essential to consumer co-operation if it is not to fall short of its purposes.

In Europe, as in America, individuals with common interests are organizing for the promotion and protection of their interests. This tendency means that a society of free competition is being replaced by a society of organizations. The individual, as producer, is ceasing to act directly and independently as an economic agent, and is increasingly acting indirectly and collectively through corporations or associations.

To many people in the democratic areas of Europe, the consumer co-operative is the instrument through which the individual, as consumer, may assert this interest. As a co-operative member, the individual ceases to obtain his economic needs as an isolated being but becomes a part of a larger collective entity.

Political Democracy is Prerequisite to Co-operative Success—In order that consumer co-operatives may become established and grow it is essential that political democracy prevail, because co-operative enterprise is fundamentally an organized self-help effort based on voluntary association. No authoritarian government can tolerate the existence of an independent segment of economic life democratically operated. The principle of members' democratic control of their enterprise cannot be eliminated from co-operatives, however, without the loss of their basic character and the destruction of their entire inner purpose. The cohesive force which creates and maintains the co-operative enterprise lies in the mutual confidence resulting from mutual participation.

Consumer Co-operatives are not to be Confused with Producer Co-operatives—Although all co-operative societies may have their origin in the desire of their members for economic betterment, co-operative pur-

poses and policies differ widely. If one is to secure clarity of definition, it is necessary to look to the economic interests of the group of persons who establish the co-operative and who constitute its members.

Those farmers who organize a marketing or selling co-operative do so in order to increase their efficiency as profit-seekers. If they organize a purchasing co-operative to buy raw materials for farm production, they do so in order to lower their costs of production and widen their margin of profits. Even though they may also buy some items of foodstuff and clothing for consumption through the same purchasing organization, the tone and attitude is set by the fact that the major objective is production for profit.

On the other hand, consumers who organize a purchasing co-operative to provide themselves with the necessities of life at the lowest cost wish to eliminate profits to middlemen. Even if they directly produce or manufacture some of the items, such as textiles, their interest is that of production for use from collectively owned, not privately owned, means of production.

The fact that a group of consumers operates a dairy or a shoe store does not make the organization a producer co-operative. Nor does the fact that a group of profit-seeking farmers operates a retail store for selling farm products or a purchasing society for buying farm supplies, make the enterprise a consumer co-operative. In all cases, it is necessary to look to the economic interests or motives of the members to classify the Association properly.

It may be concluded, therefore, that any co-operative society organized in the interest of private owners of property and to facilitate production for profit may be termed a producer co-operative, regardless of the particular service performed; and that any society organized in the interest of non-profit production for use may be termed a consumer co-operative, whether the society be engaged in manufacture or in marketing. Producer societies are capitalistic; consumer societies are collectivistic.

Co-operatives are Business Enterprises—The non-profit motive of consumer co-operatives has led many interested persons in the United States to color the movement with a quasi-religious emotionalism. They fail to give proper weight to the economic foundation. If consumer co-operatives have grown strong in certain European countries, it is because the members and leaders have recognized the economic aspects and built on basic economic functions—the consumer's inher-

ent interest in maximum quality at a minimum price—and have segregated the organizations from movements involving sentimental idealism.

In order to gain perspective on the development and practical results of consumer co-operation, it is necessary to view this form of economic enterprise in its economic setting. Just as family production of food and clothing in the old days was controlled and stabilized by the needs of the family, so co-operatives are working to satisfy needs rather than to amass profits. Their purpose is to procure the basic needs of consumers through enterprises owned and controlled by consumers.

By holding prices close to the costs of production and distribution, the consumer co-operatives have reduced the spread between producers' receipts and consumers' expenditures and thereby broadened the distribution of purchasing power. By avoiding—because there is no incentive—write-ups, watered securities and inflated capitalizations, prices of goods are more in line with income disbursed, thereby increasing the effective purchasing power of consumers. The societies are, therefore, business enterprises designed to meet specific economic problems.

Co-operative Success Based on Modern Merchandising—That this movement for consumer co-operation in Europe has been successful is due, in part, to the fact that the co-operatives pioneered in modern merchandising and retail methods. They were alert to seize the opportunity of aggressively introducing the newly developing management methods, such as inventory control, rapid turnover, cash control, mass buying, attractive display of merchandising, sanitary food storage, and managerial training. These techniques of business were developed by co-operative undertakings instead of by chain stores, as in this country. The result was that the co-operatives reaped the initial economies and became securely established.

The movement was fortunate, of course, in having as leaders men of exceptional business ability with great vision, creative capacity, and executive competence. They recognize that if the modern chain store had preceded them, the opportunities for initial economies would have been less, and the prospects for success more uncertain. Today the chain stores are beginning to invade Europe and the co-operatives find this competition more severe than that of the independent merchants. For these reasons, European co-operators believe that American co-operatives will have a more difficult time because of the firmly entrenched position of the chain stores here.

Co-operatives Desire Competition—This competition, however, is not necessarily a drawback. Many leaders of the consumer co-operative movement in Europe do not wish to see the co-operatives grow to the point where they monopolize retail distribution in any particular line of products. They desire competition, believing that competition between private retailers and co-operatives provides a beneficial stimulus for both to the ultimate gain of consumers. The co-operatives are serving the consumers generally, whether members or not, by providing a check on private business, and the leaders feel that the way should always be left open for other forms of trade to provide a similar competitive check on co-operatives if they lose sight of their objective. This objective may be stated as continuous opposition to monopoly prices in order that consumer income may have the greatest possible purchasing power, thus raising the mass standards of living.

These leaders realize that there is nothing inherent in the co-operative form of organization which guarantees a continuous policy of aggressive managership and membership. Already in Europe there are certain societies in which success has bred complacency. They have lost their objective of decreasing prices, and now seek price regulating laws and legislative protection against competition which threatens their price structure. Some societies are losing their democratic characteristics and are becoming more like large corporations with self-perpetuating managements. In these cases only 1 or 2 per cent of the members ever attend meetings or cast a vote, so management tends to become autocratic and self-seeking.

Labor Supports the Co-operatives—In theory consumer co-operation is not a class movement as all individuals are consumers. Nevertheless, it is of interest to note that consumer co-operation in Europe has received the strong support of organized labor. This is natural for the consumer movement arose as an effort on the part of property-less workers to improve their material welfare. This group consciousness has resulted in a continuing loyalty from which the co-operatives have received much of their strength. Although the middle classes are well represented in membership, the European leaders frankly recognize that the support of the labor unions has been a determining factor, and question whether consumer co-operatives can show a hardy growth in the United States without such support.

There are Limits to Co-operative Manufacture—Perhaps more

has been heard in this country of the success of consumer co-operatives in manufacturing and the production of goods than in their distribution. In a number of instances co-operatives have combatted monopolies effectively, broken trusts, and established price yard-sticks. In Sweden, for example, the manufacturing enterprises produce bread, margarine, flour, macaroni, shoes, galoshes, tires, electric-light bulbs, and a number of other articles.

The Swedes seem to be most realistic in the analysis of the possibilities for co-operative production and its significance to the national economy. They believe that a consumer co-operative should not contemplate the manufacture of any article until it has developed its retail system so that it has the machinery for the disposal and sale of the goods produced. Production without an assured market means bankruptcy. Also, a co-operative should go into production only when the opportunity exists to do a better job than is being done. Unless one can organize a business undertaking so as to gain the advantage of superior production power, one should avoid entrance. In short, say the experienced co-operators, never produce what you can buy as cheaply elsewhere.

It is further necessary, however, that the product be used directly by consumers and be subject to frequent purchase in order that the relationships between the association and the members may be continuously maintained. Production to date has been, and likely will continue to be limited to the more simple basic consumer necessities. It seems that the co-operative form of organization for production is not suited to the fields of heavy industries and public utilities of transportation, power, and communications. The so-called capital goods industries are beyond the practical economic jurisdiction of co-operative enterprise. A co-operative society may operate a bakery for the production of bread, but it is a distinctly different problem on another plane for it to contemplate the operation of a nation's railroads.

In weighing the effect of co-operatives on the stability of the national economy and the progressive increase of the public's welfare, these considerations are of vital importance, for it is probably these capital construction and equipment industries, rather than bread or galoshes, that are prime disruptive factors in our economic structure. Co-operatives are not a competitive yardstick in those economic areas where price regulation is most needed. To meet these problems, the individual must act not as a member of a co-operative,

but as a citizen of the State. In short, the experience of Europe indicates that there are certain economic activities which co-operatives can best perform, others that the government can best accomplish, and still others in which private enterprise remains superior.

Co-operatives Seek to Avoid the Use of Credit—It is important that the co-operatives have sufficient capital to be invulnerable to the financial influences of private interests. Co-operatives are financially strong in proportion to their financial independence. European co-operatives have learned through experience that economic security and stability results from the avoidance of indebtedness, on the one hand, and government subsidy on the other. Capital has been largely secured either directly from the operating members or by accumulating earned surpluses and reserves. The strongest enterprises are in all respects their members' property; the businesses rest upon a financial foundation created by the members' own capital. By following a policy of financial independence, co-operatives have been able to expand their activities without being subject to heavy debt burdens, financing charges, or creditor dictation of policies.

Of equal importance to the success of the co-operatives and national economic stability has been their policy of selling for cash and not giving consumer or installment credit. The most successful co-operatives in Europe emphatically believe that consumer credit undermines co-operative enterprises. It increases costs and makes the society dependent on outside financing because an organization that sells on credit is easily forced to purchase on credit.

The co-operatives frankly recognize that their sound economic policies have meant a slower growth than otherwise would have been the case, but feel that the growth has been more permanent. In not requesting government subsidies, the co-operatives remain faithful to their basic policy of self-help and avoid the danger of political interference.

Co-operatives Can be Educational Centers—The more successful European societies recognize that education is one of their important functions. To be strong and united, members must understand the structure, purpose and method of their association. Since a co-operative system must produce the same efficiency of business management as that of private firms, the members must intelligently choose their managers and give them technical, business training. Only by intensive educational work is

it possible to balance efficient control and democratic administration.

In a larger sense, however, co-operative educational work seeks to generate a truly social outlook. The individual is encouraged to understand the relationship between his work and that of his fellows. Not only do the farmer and worker understand the economics of their co-operative business, but also they gain an insight into the entire economic system. Members see the industrial process from raw materials to finished product. This analysis and discussion of relationships tends to counteract the effects of job specialization, develops a sense of unity and participation on the part of the individual, and thereby promotes the creation of economic democracy.

Co-operatives and Politics—Co-operation as a self-help movement originally had, and often has today, no political aspects. It was an original Rochdale principle that co-operative membership was open to all consumers without regard to politics, religion or race. All the associations desired was equal status with private business before the law.

In some countries of Europe today, co-operatives, as organizations, are not affiliated with any political party or faith. It is asserted that entrance into politics not only limits membership, but also diverts energy and funds into channels that have nothing to do with the main business of the organization—effective performance of economic functions.

On the other hand, one finds in other countries that it is the political minded who are aggressive, who attend meetings, organize, win control and throw the lot of the co-operatives with established parties. In some instances co-operatives have even been organized and established with the help of the parties. It is interesting to note that in recent years the tendency toward political affiliation is particularly marked in those countries where economic insecurity has been acute. Where there has been a widening gulf between propertied and the property-less, one finds a movement toward political action.

This observation raises a question concerning the future of consumer co-operation in America. Is political independence possible? In earlier years, when confronted with economic oppression and compulsion, people had no alternative but to find and to create their own self-help and self-saving enterprises. Given the same compulsion today, will the response be the same? Or, will the impulse be to seek relief through the State? In order to protect themselves from exploitation, Americans seem to prefer that the State act as a regulating

and controlling agency.

But whether the individual acts to protect his interests directly as consumer or indirectly as citizen, whether co-operative societies or the Government assumes the responsibility of developing the consumer's interests, only the democratic process can promote the creative qualities of the people. Co-operative experience in Europe has demonstrated that human needs can be met by group response; that such collective action can be the expression and agent of a people seeking security by democratic means in an economic world too unmanageable for individual guidance. It has further demonstrated that constant vigilance based on understanding of the true nature of consumer co-operation must be exercised if the movement is to remain a vital force.

Dairy Experiments

Condensed from Holstein-Friesian World

Dr. H. B. Ellenberger

THE question of how to produce cattle and milk more efficiently and cheaply must always receive a great deal of consideration. Nature and the cow herself give perhaps the best answer to this question. If the cow is provided with comfort, abundant feed and cheap feed of the proper character, she will produce most efficiently within the limits of her capacity. Neither cheap feed nor abundant feed necessarily means heavy grain feeding.

During the ten years that the Vermont Station herd has been under the supervision of the Department of Animal and Dairy Husbandry a creditable production has been maintained, an average of 438 pounds of fat on herd tests for the past eight years. We have been fortunate in the selection of bulls thus far but we realize that the history of many high producing herds has shown that a poor bull or two, even though they have good looking pedigrees, may undo all that has been gained during a period of years. The dairy herd improvement association program for recording complete records on all cows on test is a big step in the right direction and it is worth while for breed associations to begin thinking about the advisability of requiring records —complete records—on all registered females in the interest of real progress and breed improve-

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ment and if purebred herds are to successfully qualify as sources of bulls for other good producing purebred or grade herds.

Long time mineral balance trials at this station have shown the fallacy of including mineral supplements in all dairy rations for many, in fact, most herds, otherwise well fed and cared for do not need such mineral supplements. A ration of alfalfa hay fed with little grain or corn consisting mainly of corn and oats may be somewhat lacking in phosphorus, in which case the feeding of bonemeal is justified. There are a few such cases in the Northeastern States, though they are more common in the Middle West. A ration consisting of timothy or grass hay, or a very light allowance of hay plus a grain ration containing a relatively large proportion of high protein feeds may possibly be a little low in calcium in which case finely ground limestone may be fed. It is usually cheaper and better practice to offer the bonemeal or the ground limestone with salt at the will of the animal rather than to include it with the grain mixture. Minerals other than common salt are rarely called for by average producing herds that are reasonably well fed otherwise.

Four feeding trials during two winters have shown that cows which have the capacity to produce three to four hundred pounds of fat per year will do just as well if fed dry roughage of good quality as when fed hay plus succulent silage, provided, of course, that they have free access to water in drinking cups. The question of whether to grow and store silage or not may be answered by giving careful consideration to the cost of total digestible nutrients in the silage as compared to those in good quality hay. Available data indicates that on the average for the country, nutrients in hay cost only about two-thirds as much as they do in silage. Records for two years at the University Farm indicate that under our conditions nutrients in hay cost only about 60% as much as they do in corn silage.

Our feeding trials have proven that artificially dried hay is more valuable than naturally cured hay due to increased yield, conservation of the leaves, the most valuable part, and a lack of losses caused by exposure to the weather. Of course the cost of artificially dried hay is more than that of naturally dried. Overhead, depreciation, fuel, labor and land rent considered, costs of artificially dried hay may range from $12-$16 per ton depending upon yield, location, etc. Total digestible nutrients in the good hay at $15 per ton cost about $1.50 per 100 lbs. and in grain at $45 per ton about $3.00

per 100 lbs. With grain costing $45 per ton hay of this quality would be worth about $30 per ton. If hay of this quality is fed, the grain allowance may be greatly reduced. Therefore, I believe that artificial drying is becoming practical for large farm units though the cost of equipment is still too high for small farms.

We are making a careful and long time study of methods of conserving the nutrients in roughage for winter feeding. The artificially dried and naturally dried products are being compared to grasses and legumes preserved in the silo without any treatment or with the addition of molasses or mineral acids. In this northern country many farmers may put up grass silage more cheaply than corn silage. Moreover, at the beginning of the hay season losses caused by unfavorable weather may be curtailed by putting a portion of the hay crop into the silo. This is more practical than artificial drying for the small farm although the nutrients of the silage may cost as much as do the nutrients in artificially dried hay under larger unit operations. Our trials thus far indicate that for the best results grasses and legumes should go into the silo containing approximately 65% water or 35% dry matter. Either grasses or legumes will make good silage without the addition of molasses or acids if the moisture content is just right, but under ordinary farm conditions it is probably a good insurance policy to add two to three percent of molasses to the green materials as it goes through the cutter. This will aid in preserving the nutrients should the moisture content be a little low or a little high.

The effect of quality of hay and of vitamin supplements has been studied during a feeding trial with 24 calves that have now reached 16-18 months of age. Calves fed alike except for the quality of hay indicate that when receiving good quality of hay they weigh as much at eight months of age as do calves on poor quality hay at ten months, and as much at thirteen months of age as calves on poor quality of hay do at sixteen months of age. Calves fed alike except for vitamin supplements in the form of cod liver oil concentrate showed little or no difference in the rate of growth, those fed no supplement having gained as fast or slightly faster than those that received supplement. Feed costs, including the vitamin supplement, per pound of grain to sixteen months of age, were:

Lot 1—Good Hay, No Supplement	8.3c
Lot 2—Good Hay, Plus Vitamin Supplement	8.7c
Lot 3—Poor Hay, No Supplement	9.0c
Lot 4—Poor Hay Plus Supplement	9.9c

Developments along the lines mentioned above all appear to point toward greater utilization of grasses for the production of which our New England soils and climate are well suited. With more and better quality roughage on farms having cattle of average quality, grain feeding may possibly be reduced one-third to one-half. Also, on a system of grass land farming labor costs are less. While there is little conclusive evidence available, many careful thinkers feel that such a system may well increase breeding efficiency which is a vital factor affecting the cost of milk production.

Compost

FARMER I. E. FARRAR, River side county, California, makes compost manure at the cost of $1 a ton out of such material as alfalfa leaves, weedy hay, grain straws and barnyard manure—materials which oftentimes go to waste. A reagent to speed up the decay of composted materials is made up of a mixture of 50 pounds sulfate of ammonia, 70 pounds agricultural gypsum and 25 pounds of finely ground limestone. The amounts are for one ton.

Material to be composted is placed in piles about eight feet wide, two feet high and any convenient length, reagent is scattered on top. Another layer is added to make the pile about three feet high, and again reagent is scattered on top. The pile is then topped off with a thin layer of fine material to reduce the escape of ammonia gas formed in decay. If the material is not already wet from rains, it is sprinkled as it is being piled.

This composted manure has twice the value of ordinary dairy manure. The compost decomposes in about four months under average conditions, is put on the fields with a manure spreader.—*Currie*

Discovered—What It Takes to Make Lambs Market Toppers

Condensed from Breeder's Gazette

Claude Harper

Purdue's Sheepman

INDIANAPOLIS rated as one of the highest live lamb markets in the U. S. many times last year. Twenty years ago Indianapolis was one of the poorest live lamb markets in the entire U. S.!

This change came about, not because of the numbers of lambs marketed there, but because of the killing quality of the lambs offered for sale. Better breeding and improved feeding practices are responsible for the change.

Five years ago, fully 80% of the lambs marketed through the Evansville, Ind., stockyards graded medium or below in the carcass. In 1937 over 80% of the lambs graded above medium in the carcass. There are two things responsible for the change. First, more than 1,000 purebred registered rams were introduced into the area for breeding purposes on grade flocks. Second, an educational program with the growers emphasized feeds adapted to economical lamb production and the relation of quality to palatable lamb meat. Further improvement will be made in this area when the purebred rams used there are more uniform in development and have shorter-coupled bodies and a type appealing to the owners of grade flocks.

The sheep industry has changed from a wool business to a meat business during the past 60 years, yet there has been a definite prejudice among many people against the palatability of lamb meat. Why this prejudice! During the past ten years the Purdue Exp. Station in co-operation with the U. S. D. A. has attempted to find why lamb meat was unpalatable to some people. Hundreds of lambs were used to get facts. It was discovered that lambs slaughtered when in feeder flesh made undesirable carcasses, gave unsatisfactory yields, and the meat was unpalatable when cooked. It was also discovered that lambs properly fattened and finished before they were slaughtered made desirable carcasses,

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satisfactory dressing yields, and provided a palatable, delicious product when it reached the table. In other words, it was found that common and cull lambs did not make a good meat product and the meat produced by such animals is probably more unpalatable than that produced by cull cattle, cull hogs, or cull poultry.

In our practices of sheep production in this country today we are following many of the same methods of feeding and management that were used when wool was the chief source of income. The more I work with sheep the more I am convinced that quality lamb meat is produced most economically and satisfactorily from certain types of feed.

Maturing beef cattle are more economical utilizers of mature permanent pasture and non-leguminous roughage than are sheep and lambs. We must look to beef cattle to consume most of our permanent pasture in the summer months, and our non-leguminous roughage in the winter. True, some non-leguminous roughage can be used in sheep feeding, but it must be remembered that the more leguminous roughage used in sheep feeding, the lower the cost and the better the product.

Sheep need the same kind of pasture in summer and the same type of feeds in winter that dairy cattle utilize economically. Sheep will continue to find a place in those areas in the farming states where legume crops are produced and where summer pasture is green, tender and succulent.

Internal parasitic diseases have been held responsible for contributing most to our annual crop of cull lambs. The stomach worm, tapeworm, nodular worm, whipworm, hookworm, and lungworm have helped to make many lambs unthrifty and have undoubtedly killed some. They will continue to be hazards but there are other reasons why lambs may be culls or in feeder flesh at weaning time from a nutrition standpoint:

1. Improper feed for the ewes during the gestation period.
2. Unsatisfactory feed for ewes during the suckling period.
3. The lack of supplementary feeds for lambs before pasture is available.
4. Undesirable and unsatisfactory pastures for ewes and lambs.
5. Lack of supplementary succulent pasture when permanent pasture matures and dries.
6. An insufficient milk supply given by ewes during the suckling period.

Any of these factors, or a combination of them, may result in lambs with feeder flesh regardless of parasites. Likewise, they handicap the breeder of purebred stock in developing those good,

big rugged yearling rams that farmers like to buy. When a commercial lamb producer fails to make the major portion of his lambs fat at weaning time, it means that the lambs must be weaned and fattened on supplementary feeds and pasture, provided they can be made fat at all. Thrift throughout the first year of a lamb's life is most important.

In the past we have been taught to recognize that sheep are adapted to a wide variety of feed for grazing. Until recently it was not generally recognized that when permanent pasture on the farm has matured, lambs fail to maintain finish or produce gains. When lambs pastured on permanent pasture in the cornbelt in the summer months are compared with lambs pastured on permanent pasture during the spring months and then put on supplementary legume pasture or other succulent types during the remainder of the summer months, it is found that there is a difference of 10 to 15 lbs. per lamb (gain in forty days) in favor of the latter group.

If the business of producing lambs in the farm states succeeds and expands (in competition with the western range states), major production of the lambs must be sold in good killing flesh and ahead of the season of the year when the bulk of range lambs are coming to market. This method of production demands the use of good breeding sires and ewes which have inherited the ability to furnish their lambs a liberal supply of milk when well fed.

There are hundreds of flocks of purebred sheep in the central west that would be good flocks if they were given greater quantities of legume hay and a grain ration during the winter months and a green succulent pasture other than permanent pasture during the summer months.

Making Beef With Ayrshire Steers

Condensed from The Ayrshire Digest

Harry S. Leber

Manager of Spring Hills Farm, Cockeysville, Maryland

THAT the Ayrshire is unique among the dairy breeds in its ability to produce beef of really good quality has been strikingly demonstrated by a group of ten steers bred, fattened and marketed by Spring Hills Farm, Cockeysville, Maryland. Sold at the farm without shrinkage, the ten steers that grossed 10,480 pounds, realized $1100 or $110 each, or just under $10.50 per cwt. But, so attractive were these cattle that they were resold at a reported advance in price to $12.50 per cwt., which compared very favorably with the price for better grades of fat cattle, about April 12, when they were marketed.

At the Baltimore stockyards, these cattle were enthusiastically received as the best lot of steers that had been sold there in many a day. And when they were slaughtered, they were just as well appreciated by the meat dealers who saw their carcasses.

Although their live weight was taken with practically no shrinkage, these steers made the very creditable dressing percentage of 57.52%. According to competent judges "the shape and thickness of the carcasses were very good," although several of them were criticized for having excessive fat, particularly about the kidney—a rather unusual condition for dairy-bred steers at an average age of nineteen months. Later cuts were taken from their carcasses and subjected to a palatability test by experienced judges who rated them high.

The foundation members of the Spring Hills herd were from some of the breed's most productive families. The making of beef was at no time considered as an objective in the selection of the individuals or the bloodlines of the ancestry of these steers. Any beef-making tendencies which they may have possessed were simply an inherent by-product that came with their high producing parentage.

With a surplus of bulls on hand, and an abundance of roughage, it was decided to experiment by castrating them and

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fattening them for the nearby Baltimore market, which seemed to appreciate good beef.

These cattle were born between August 14 and November 1, 1935, and were castrated on February 11, 1936, at an average age of about five months. A later group of steers has been castrated at eight weeks of age, which it is believed will greatly improve their quality.

Since Spring Hills is on Herd Test, and since there are no provisions for nurse cows in the Ayrshire Herd Test plan, these calves were hand fed, just like other dairy calves, receiving the usual amount of skim milk and the minimum of whole milk.

On January 1, 1936, the steers were placed on a daily ration of 3.2 pounds of grain per steer, consisting of:

200 pounds corn and cob meal
200 pounds ground oats
100 pounds linseed oil meal
100 pounds bran
7 pounds salt
7 pounds minerals

This mixture, which is figured at $35 per ton, was fed until September 1, 1936, being gradually increased until each steer was getting 3.6 pounds per day in April (when eight months old); 4.0 pounds per day in May; 5 pounds per day in June and July; and 6 pounds in August.

On September 1, 1936, the ration was changed to the following proportions:

200 pounds of ground corn and cob meal
200 pounds of oats
160 pounds of oil meal
100 pounds of cottonseed meal
100 pounds bran
7 pounds salt
7 pounds minerals

This mixture, which was valued at $38 per ton, was fed up until March 1, 1937. During the month of September, each steer received 6.5 pounds per day; in October, 7 pounds; in November, December and January, 8 pounds; and 10 pounds per day up to February 15, when the allowance was increased to 14 pounds per day.

During the month of March, the mixture was changed to a more intensive fattening ration, consisting of:

1200 pounds of corn and cob meal
100 pounds oil meal
100 pounds cotton seed meal

This was valued at $45 per ton, and the steers received an average of 14 pounds per day. All through the feeding period, liberal quantities of homegrown hay and silage were fed. The hay was valued at $15 per ton, and the silage at $4. The steers consumed $602.73 worth of concentrates between January 1, 1936, and April 12, the day that they were sold on the market. Their entire feed cost, including hay

and silage, was $933.39.

At present, there are a dozen more Ayrshire steers on feed at Spring Hills, and there are also a number of other breeders in various sections of the country who are planning on either marketing Ayrshire beef or of enjoying some of it on their tables. It is particularly significant that the Ayrshire seems to possess the essential qualifications for making a very acceptable beef carcass, while at the same time, maintaining its premier position as the leading dairy breed in the economical production of 4% milk.

Learn Your Soil's Limiting Factors

Condensed from Better Crops with Plant Food

Ford S. Prince

Agronomist, New Hampshire College of Agriculture, Durham, New Hampshire

OUR thought with respect to fertilizer needs is constantly changing, in that there are being discovered new elements or substances that act as limiting factors, preventing optimum plant growth, often to the point of unprofitable production. Nor is this true only of newly-discovered materials, for it still holds true of the three "essential" elements as it always has.

We might venture to say that the leaching which normally occurs in humid climates is partially responsible for these changing conditions. Cropping, erosion, and any other source of loss of nutrients from the soil are doubtless contributing factors.

Take a specific illustration, such as the New England potato crop. Ten years ago the idea that this plant needed individual nutrients not found in the ordinary fertilizer was unknown. Then came the discovery in Maine that a peculiar chlorosis, typified by a yellowish bronze color of the leaves, could be overcome by spraying the vines with soluble magnesium salts, and a new chapter in Maine potato history was written. Magnesium hunger typified by the chlorosis has now been overcome by putting the magnesium into the fertilizer, and the healthier crops that are produced respond to this treatment by digging out as many as 70 bushels more potatoes per acre, at an increased cost for the magnesium of only a dollar or so per acre. In this instance the inclusion of magnesium changed the yield as much perhaps as increasing the amount of fertilizer 50 per cent or more.

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This is but one of the limiting factors that may affect the New England potato crop. Leaching and cropping which have contrived to deplete the magnesium and calcium have caused a corresponding rise in the acidity of the soil. Land below pH 5.0 is common, and reactions as low as pH 4.0 to 4.5 are not unusual. At these acidity levels clover fails, bacterial activity is probably inhibited, and even the potato crop, one which is not highly sensitive to an acid soil, does not produce optimum crops. Extreme acidity which causes high solubility of iron and aluminum means that phosphorus and potash too are taken out of available form and cannot be secured by the plants. High fixation and low bacterial activity may easily mean a severe reduction in yield. The trouble may be overcome by liming, of course, but too much lime causes scab and farmers are a little chary about applying it.

According to principles laid down at the Maine Experiment Station and announced by Dr. J. A. Chucka, agronomist there, scab can be avoided and lime can be used if applied in small amounts in the potato rotation; not to exceed 1,000 pounds of ground limestone if the soil tests below pH 5.0, and not more than 500 pounds if the soil runs pH 5.0 to 5.3. Furthermore, any lime that is used should be applied after the potatoes are grown and before clover is sown so as to get the maximum benefit from the lime on the clover and to reduce scab-causing tendencies when potatoes are next planted. In New Hampshire lime in the above amounts at a soil reaction of pH 5.3 has not caused scab, but in amounts of 2 and 4 tons scabby potatoes have been produced no matter what the reaction of the soil.

The proper use of lime under conditions such as have been described tends to overcome another limiting factor in potato production, and that is the lack of organic matter. Potatoes are not heavy users of plant food derived from this substance, although it is advantageous to supply them with nitrogen from the organic source. It is very advisable to have the soil well supplied with it though, to absorb and furnish moisture and overcome the effects of drought and midsummer heat which often seriously reduce yields. The utilization of a clover sod has given an average yield increase of 50 bushels per acre in our New Hampshire 300-Bushel Potato Club. This quickly-decaying organic residue means more nitrogen for the crop and more moisture during the growth period.

These points have been mentioned with respect to the New England potato crop to indicate

that it is not always a lack of the plant-food elements, nitrogen, phosphorus, and potassium, that causes relatively low yield levels, although a grower must know his soils and their needs for these elements. Other factors are constantly cropping up, like magnesium in various parts of New England, to work havoc with plant growth and yield unless the symptoms are recognized and overcome with proper treatment.

Many of these special conditions have already been recognized and remedied in a broad general way, such as the application of sulphur on soils of the Pacific northwest. It is quite possible that the humid northeast region would be suffering from a sulphur deficiency were it not for the fact that fertilizers carrying sulphates, such as the ammonium sulphate and calcium sulphate in the superphosphate, have been constantly applied.

The use of copper on the Florida Everglade soils is another case in point. According to Superintendent Daane, of the Belle Glade Substation, before cropping is in any wise successful, an application of copper sulphate must be applied to this type of soil. Once this is made, response is secured from potash and phosphorus, but until copper is applied there is little use to fertilize with anything, so serious is copper deficiency.

This appears to indicate a very delicate balance of soil nutrients for correct plant growth. Unless this balance is maintained, yield results are unsatisfactory and the growth is often accompanied by symptoms of mal-nutrition either on the foliage or in the roots, fruit, or in the quality of the crop produced.

All this discussion about boron is pertinent in this connection. So many instances of nutritional difficulties with cabbage, cauliflower, turnips, and other crops have been noted and traced to boron deficiency that there can be little doubt that boron is the guilty member of the plant-food group. However, a couple of decades ago this element was considered merely an accidental one in plants, absorbed by plant roots merely because it was in solution in the soil, but not utilized in plant nutrition.

It is, of course, unfortunate that boron in large quantities is toxic to plants. This fact, apparently indisputable, has tended to obscure the beneficial effects of the substance when applied in limited quantities. So many favorable effects have now been reported for its use that a new avenue of research has been opened up involving the limits of tolerance, the losses that occur to the element by leaching, its effect on a whole range of crops in regions

where it has been found to be deficient, and particularly, accurate soil tests for the availability of the substance, if any is present in the soil, to the extent that it may be predicted with more or less accuracy whether its application is necessary for optimum plant growth. Furthermore, a whole range of crops must be examined to ascertain whether boron need for one crop is greater than that for another in regions where the element is found to be deficient.

It would be ideal if all crops were like tobacco and would show by characteristic growth habits which element is lacking as a nutrient deficiency, so that the lack could be directly met. Most of them probably do to a greater or less degree, and it remains for these symptoms to be diagnosed for proper remedy. Even if these symptoms are patent to the trained investigator, they are still mostly beyond the ken of the farmer, and in his mind any difficulty that crops up is more likely to be diagnosed in the light of his information as disease symptoms rather than those of malnutrition.

A good many of the soils of the northeast region are on a rather delicate balance with respect to nutrient elements, as well as with soil acidity. In some cases acidity is at the point where the application of an acid fertilizer will depress the yield when compared with one which has had enough limestone added to neutralize the acids developed by the fertilizer itself.

Another point of particular interest to potato men with respect to neutral or basic fertilizers is that these are applied with the planter in narrow bands, and the acid-forming elements may leach out and not be neutralized by the lime that has been added, which would tend to leave zones of soil in which there would be enough lime to promote potato scab.

Copper is not likely to be a limiting factor on potato farms. On other farms where bordeaux sprays are not applied this element may cause plant disturbances, although its lack is probably more pronounced on organic soils, such as the mucks and peats sometimes used for vegetables and special crops. The same is true of manganese, but this element is often thrown out of availability by overliming operations, and it may be necessary to remedy the difficulty by applying manganese in a form suitable for fertilizer use.

No one is ready yet to state that boron and these other elements should be mixed into all the fertilizers in the northeast. The extent to which the soils have suffered by leaching, by crop removal, by the sale of livestock and its products, and by

other means through which fertility is lost is yet to be ascertained. Certain it is that leaching and cropping, pasturing, etc., still go on, taking their toll of valuable and limiting elements that sooner or later must have attention by farmers and fertilizer manufacturers.

Mouse Control

Condensed from New England Homestead

W. W. Dykstra

IN New England there are more mice than any other single group of mammals. Fruit growers, gardeners, beekeepers and greenhouse operators have long been familiar with their destructive habits and will be glad to know that improved methods have been devised for their control. Damage such as is often seen in girdled trees and shrubs, nibbled apples, celery devoid of hearts, riddled honey combs and ruined flowers can be prevented.

How to Combat

Recent investigations of the United States Biological Survey have thrown light on these seemingly unimportant little animals. As is true in the case of all wildlife, mice have their purpose in the pattern of nature. They serve as part of the food chain of our higher animals, including the fox, skunk, weasel, black snake, hawk and owl, which devour them in large numbers. With the advent of man, these natural predators on mice have been reduced in numbers. Cultivation of crops has brought about an abundance of food for mice and a consequent further increase in their population. Conversely, proper utilization of the forces of nature can also be used to combat them. Protection of natural predators, maintenance of level orchard floors, and close mowing of grass will do much toward keeping their numbers down.

Different Species

In New England six species of mice are more or less common. Some, adapting themselves to man's pantry, are known as house mice, and every housewife attempts to keep them under control by use of traps. Others prefer grain or seeds and constitute the group termed deer mice, so called because of their delicate fine features, color and large eyes and ears. White undersides and feet add to their beauty. Our forests shelter the seldom seen red-backed mouse, and in some sec-

Reprinted by permission from the New England Homestead, March 12, 1938, Springfield, Mass.

tions, one that is famous for its ability to make long leaps, the jumping mouse. Another species, found in pine forests, is appropriately termed pine mouse. The most common of all mice has a liking for succulent grass roots and its called the meadow or field mouse.

Telegraph Signals

A study of these rodents reveals interesting information about their habits. In greenhouses some mornings fragments of red carnations are found that had been chewed the previous night, while pink and white carnations are untouched. On other occasions they may be heard telegraphing danger signals to one another by a rapid thumping of feet on a hard surface, such as a tin can. One investigator, D. A. Spencer, has developed a sensitive electrical recording device that makes possible a study of their movements under field conditions. In this way we know that the meadow mouse is most active about eleven o'clock in the morning and again at four in the afternoon. During cold, wet weather its activity is much less.

Baits in Runways

Food-preference tests show that apple is the most readily accepted bait for meadow mice, and since these particular rodents stay in trails and seldom come out into the open, it is essential that baits be placed directly in their runways. To facilitate locating these trails, it is recommended that the orchardist place small clumps of hay, fertilizer bags, or old boards near each tree during summer months. These serve as cover to concentrate the mice and simplify control operations. During the late fall the orchardist should visit each of these stations, and if trails are present, he can drop baits in them and see that they are carefully covered. Thus, the baits present little danger to other wildlife.

Specific Control

Since only pine and meadow mice are responsible for girdled trees, and because among the commoner species these are the only trail-building mice, a specific control method is possible. Apples are cut in half-inch cubes, dusted with a specially prepared rodenticide, and placed directly in the mouse runway. Drainage ditches, stone walls, and low meadows adjoining orchards are treated as well as the area around each tree, as these are principal breeding places. Supplied through co-operation of the Biological Survey, this rodenticide is both effective and economical. Ten cents worth of the material is sufficient to treat 500 trees, and the operation need be carried on only once each year.

Damage Underground

Orchardists throughout New England have shown grave concern over the pine mouse. Damage done by this pest is underground and often escapes notice. Injured trees have thin leaves and bear small undeveloped fruit. The pine mouse is common in Connecticut, and its range extends as far north as southern New Hampshire. Its trails differ from those of the meadow mouse and are generally found just beneath the surface. These mice seem to prefer light sandy soil in heavily mulched orchards. There, too, placement of apple baits directly in trails under cover is essential for control.

Through the co-operation of State Extension Services, Pomological Societies and State Departments of Agriculture with the Biological Survey, orchardists representing two million apple trees in New England have already taken advantage of improved practices.

Diseased Carcass Disposal

Condensed from Capper's Farmer

Thomas H. Bartilson

ONE of the most unpleasant tasks of the livestock producer is the disposal of the occasional animal that dies. If a calf has died of blackleg or a hog of hog cholera, the task is not only unpleasant but highly exacting. For upon the proper disposal of the carcasses of all animals dying of infectious diseases may depend the welfare of every animal on the farm or in the neighborhood. Such carcasses, carelessly handled, can be sources of infection for years to come thru contamination of lots and pastures.

To play safe no matter what the specific cause of death, carcasses should be completely destroyed by fire. This task can be facilitated if some simple equipment is kept on hand. A section of old iron fence, an old steel implement wheel of sufficient size, an old harrow or similar piece of discarded equipment suitable to form a grating for an emergency incinerator is all that is needed.

This grating should be laid across stones piled high enough or over an excavation deep enough to provide sufficient clearance for enough brush and wood in the fire pit underneath to assure complete destruction of the carcass. If possible the carcass should be burned where it lies to

Reprinted by permission from Capper's Farmer, Topeka, Kansas

prevent the danger of spreading infection in moving it to another spot. But if moving is necessary, the dead animal should be hauled to the new location on a drag or sled that is well bedded with straw or hay to catch any discharges from the carcass. Under no circumstances should the carcass be merely dragged across the ground.

To insure rapid burning, the carcass should be thoroly slashed to let out the fat drippings as it burns and should be liberally soaked with kerosene before the fire is lighted. If the entire carcass is not destroyed at the first attempt a second fire should be built under it before there can be any chance of bits of carcass being scattered over the farm by dogs or wild animals.

All spots around the farm that have been exposed to possible contamination should be disinfected with a compound solution of cresol at the rate of at least 4 ounces to the gallon of water or one of the recognized commercial coal-tar dips or disinfectants.

If for any reason, burying the carcass is preferred to burning, it should be buried at least 6 feet deep and covered with quicklime before dirt is filled in. Because of the danger of contaminating subterranean water supplies, of the carcass being disinterred by dogs, wild animals, or erosion, or of the infection being unearthed in future digging operations, burying is not considered nearly as safe a means of disposal as burning.

One word of caution. In working with the carcass of any animal that has died of disease, always wear gloves, and perferably rubber gloves. This precaution may save you serious infection.

Manure Loading

START loading the spreader at the front end and work toward the back. See if it doesn't pull a little easier and watch it do a better job of spreading.

Use of Artificial Light for Poultry

C. S. Platt

Asscoiate Poultry Husbandman, N. J. Agri. Experiment Station

RESEARCH in recent years has demonstrated without question of doubt that the effect of artificial light upon birds is to promote ovulation, or the production of eggs. The belief formerly held that the use of artificial light provided a longer day for the bird, thus enabling her to consume more food with a resulting increase in egg production, has been generally disproved. Therefore, if placing birds under artificial light is to be considered as a stimulant to egg production because of its effect upon the ovaries, it would seem well to use the light with some discretion. To do so, however, requires a knowledge of the amount of normal daylight a bird receives. This information is shown in table 1.

Reference to this table shows that the longest days are of 15 hours duration and occur during the month of June, and that the shortest days are 9.3 hours long and occur in December. The greatest egg production without aid of artificial light is obtained during May and June, when normal daylight is at its optimum. On the other hand, the lowest egg production without artificial light occurs during the short days of the late fall and early winter. Of course, other factors, such as temperature, molt, and age of the birds, also affect fall and winter egg production, but light does have an important bearing, as is evidenced by the increase resulting when birds that are laying at a mediocre rate in the fall are given the benefit of a longer day by the use of artificial light.

When to Use Artificial Light

A flock of pullets of the more common breeds of poultry generally start producing eggs when they are between 5 and 7 months old. By the time they reach the age of 7 months, production should exceed 50 per cent. This condition is normal and usually will be realized without the use of artificial light. Frequently, however, birds that are hatched late in the spring, or for some other reason develop slowly, do not reach a production level of 50 per cent at 7 months of age. Such

birds can have their production increased quickly by the use of artificial light to the extent of 1 hour in excess of the hours of daylight at that time. If this practice is started early in the fall, it will be found necessary to increase the amount of artificial light at least twice monthly in order to compensate for the decreasing hours of natural daylight. Table 1 will be found useful as a guide in following such a program.

Artificial light should not be started in a flock that is under 7 months old, however, as such a practice simply forces the birds into production. More eggs will be produced immediately if the birds are provided with extra light even though they are somewhat under age and probably underweight, but there will be a lowering of production later on and a greater proportion of peewee and pullet eggs than would have been the case if the flock had been allowed to develop naturally. From an economic standpoint, the question of which is the better practice is a difficult one to answer. Local conditions, egg prices, health of the flock, season of year, date of hatch, and general plan of farm operation all need to be considered. A flock of birds will have a tendency to produce eggs in about a definite amount, depending upon the breeding and health of the stock. This production can be increased very little by the use of artificial light. It can be shifted in its seasonal distribution, however, and that is one of the chief advantages to be gained from the operation of a lighting system.

Probably the best plan for the use of light is to permit a flock to come into production naturally and then start lighting when the production level drops below 50 per cent as measured over a period of 1 week. This practice has had the effect of maintaining a satisfactory egg production during the late fall and early winter on January and February hatched pullets at the Agricultural Experiment Station, when birds not receiving artificial light went into almost a complete molt. The light was increased 1 hour every time the production fell below 50 per cent for a 7-day period. Actually, the light had to be increased about 1 hour every third week after September 1, and eventually the birds were receiving artificial light from 2 A.M. until daylight. In any event, it is not advisable to give a flock too much light at the start, unless a high production is wanted immediately. In such instances a drop in production can be expected later. Regardless of when and how artificial light is used, it should be discontinued in the early part of April, the amount being reduced gradually each day.

Table I

Approximate Time of Sunrise and Sunset and Total Possible Hours of Sunlight in the State of New Jersey at Semi-monthly Intervals*

Date	Hour of Sunrise (E.S.T.)	Hour of Sunset (E.S.T.)	Total Hours of Possible Sunlight
Jan. 1	7.23	4.46	9.4
Jan. 15	7.21	5.00	9.7
Feb. 1	7.10	5.20	10.2
Feb. 15	6.55	5.36	10.7
Mar. 1	6.35	5.52	11.3
Mar. 15	6.13	6.06	11.9
Apr. 1	5.46	6.25	12.7
Apr. 15	5.24	6.39	13.3
May 1	5.02	6.55	13.9
May 15	4.46	7.09	14.4
June 1	4.34	7.23	14.8
June 15	4.31	7.30	15.0
July 1	4.35	7.34	15.0
July 15	4.44	7.29	14.7
Aug. 1	4.59	7.15	14.3
Aug. 15	5.12	6.59	13.8
Sept. 1	5.27	6.34	13.1
Sept. 15	5.41	6.11	12.5
Oct. 1	5.57	5.45	11.8
Oct. 15	6.11	5.23	11.2
Nov. 1	6.29	4.59	10.5
Nov. 15	6.45	4.45	10.0
Dec. 1	7.03	4.37	9.5
Dec. 15	7.15	4.37	9.3

*Compiled from the American Nautical Almanac

The use of extra light generally is advisable also at the end of a production year, beginning about August 1. By referring to the table, it will be noted that the days are almost 1 hour shorter on August 1 than on July 1. At this season the egg production of a flock naturally tends to drop, but the rate of decrease can be noticeably lessened by using sufficient light to maintain a full 15-hour day until the time that egg production does not warrant the cost of continuing the light. This generally will be about October 1.

Breeding birds will molt more evenly, come into production more uniformly, and produce more eggs during the hatching season if not given any extra light from October 1 to January 1. After the latter date, the use of artificial light from 5 A.M. until dawn will give a plentiful supply of good hatching eggs during late January, February, and March, if stock is satisfactory and the feeding program properly carried out.

Feeding Under Artificial Light

When artificial light is being used for breeding hens, the practice should be to encourage the consumption of more mash than grain, or to use a moist mash containing alfalfa leaf meal and dried milk in some form, so as to insure a proper intake of Vitamin G, which is essential for the hatchability of eggs.

On the other hand, flocks of pullets under artificial light should be fed to encourage a grain consumption slightly in excess of mash consumption in order to prevent excessive production and to maintain body weight.

Too Many Bruised Apples

Condensed from American Fruit Grower

C. W. Ellenwood

Ohio Experiment Station

ONE of the most disheartening things that can happen to a fruit grower after he has succeeded in growing a crop of fine quality fruit is to be informed by his dealer that the price will have to be discounted on account of bruising.

Of course, "poor condition" was a phrase once employed to cover up a racket of unscrupulous dealers and merchants regardless of quality. It was particularly useful when the market was slow. Nowadays there is comparatively little of this sort of trickery practiced by commission men and dealers. A grower may, if he is so inclined, blame apple scab and codling moth injury on the weather, his luck, or some other factor beyond his control, but bruises are for the most part man made. It should be remembered, though, that the problem of eliminating mechanical injuries does not belong entirely to the grower. Transportation agencies, merchant, and consumer are all involved.

Unfortunately for the grower, he is generally blamed for all the bruises that occur from tree to kitchen regardless of what the middleman may do to the fruit.

For several years there has been a growing concern among fruit growers about this matter of injuries, but not much has been done to discover the main sources of bruising. Until the origin of the most serious damage has been located, obviously not much can be done about correcting the situation.

The Ohio Experiment Station last fall started a series of observations on harvesting and grading operations to check the condition of the fruit as it moved from tree to storage. For the purpose of these observations, it was assumed that any operation which involved moving the apples was a focal point for bruises. Three varieties of apples, McIntosh, Grimes, and Stayman, were chosen for the 1936 tests. Three men, all of them with several years of apple picking experience, were used as pickers. These men were selected from a larger crew because they were thought to represent different types of work-

Reprinted by permission from American Fruit Grower, 1370 Ontario St., Cleveland, O.

men as to speed and care of handling fruit. None of the men was apprised of the fact that the apples they were picking were to be especially examined later.

Each of the pickers used three different types of picking containers: (1) the conventional padded picking bucket; (2) the standard heavy canvas bag; and (3) a round half bushel basket padded with canvas.

The apples were harvested at the regular time for picking each variety. Examination for bruises, however, was not made until the fruit had been in storage several weeks and had ripened sufficiently for the bruises to be easily visible. The following are some of the results noted from the tests as the apples were moved step by step from tree to storage.

Of the McIntosh 1.5 per cent showed sufficient bruises on the tree before they were picked to keep them out of the first grade. The other two varieties had less than one bruised apple in a hundred on the tree. While the movement of the tree by wind and the dropping of windfalls cause some bruising, only under abnormal conditions would bruising on the tree be severe.

Influence of picking on the amount of bruising, as might be expected, varied with the picker. The speediest picker, taking into consideration the fruit he picked using all three types of containers, bruised about 10 per cent of the apples so badly that they were taken out of the first grade. The second picker bruised six per cent, while the third picker bruised only three per cent.

A summary of 1936 results shows no appreciable difference in the amount of bruises in the three types of picking containers. The padded bucket has been quite generally accepted as the one least apt to cause bruising. In this test, however, there was actually a little less bruising in the bag than in either bucket or basket. Baskets cost about twice as much as bags.

A comparison between field crate and basket showed practically no difference in the amount of bruising.

It was found that practically half of the bruising which occurred during the picking operation was due to dumping the apples into the container. In this connection it was observed that slightly less bruising resulted from emptying the bag than the bucket.

There was practically no difference in the amount of bruised apples hauled from orchard to storage on a wagon mounted on flexible springs and those hauled on a small truck.

We come now to the most important source of bruising—the grading operations. Although records of this test show that the

picking operations in the orchard may be and perhaps often are a source of too much bruising, this phase of harvesting is not to be compared with the grading operations as sources of bruises.

The grading machinery used in the test consisted of a modern washer and sizing machine. This equipment could be rated average or above average so far as preventing bruises was concerned, but a close examination of the apples after they had reached the storage showed that as high as 45 per cent of the apples were bruised. This does not mean that this bruising would in all cases make the fruit unsalable. Much of the fruit in the test, however, had to be placed in a grade or two lower than would otherwise have been true.

A study of these grading records emphasizes the need for padding, with sponge rubber or some other cushioning material, every possible point about the grading equipment where there is movement of the fruit. This ought to be a matter of concern not only to individual growers but to manufacturers of graders as well.

It seems wise, also, to emphasize the need for close supervision of pickers and grading crew. This human element is perhaps a little more amenable to correction than some of the rapid-moving machinery used in harvesting and grading. Finally, it will sometimes be necessary to choose between speed and bruises on the one hand and more deliberation and fewer bruises on the other.

Sawdust Bedding

SAWDUST and shavings are sometimes called upon for a little service when straw or other bedding becomes scarce. The question often is asked as to just what this type of bedding may mean or do to the soil.

Reports from experiment stations show that sawdust absorbs about three times as much water as ordinary straw; the nitrogen content is about one-half that of straw, and potash and phosphorus are about the same. A representative analysis of sawdust contained 0.2 per cent nitrogen, 0.1 per cent phosphoric acid, and 0.2 per cent potash. Manure and sawdust should be piled in compost piles in order to bring about partial decomposition. This eliminates any seriously bad effects on the soil and minimizes its bringing about an acid condition.

Quickest Way to Stop Milk Flow

Condensed from Farm and Ranch

MAINTAINING a steady and sizable flow of milk is the big problem with the average cow used for dairy purposes, according to E. E. Anderson, of the New Mexico State College. The farmer's least worry with such cows is to devise ways for stopping milk secretion. On the other hand, with the higher producing and persistent milkers, producers are often faced with the problem of how to stop the milk flow without injury to the animal.

In the latter case, probably the best and most rapid method is to discontinue milking abruptly. Then, if the udder fills so much with milk that there is danger of its becoming congested, the cow should be milked out clean and only milked again as the necessity arises. This method dries up the milk much more rapidly than the older method of gradually decreasing the frequency of milking, first to once a day, then once in two days, etc. For cows producing not to exceed two gallons of milk daily there is no danger if the milking is stopped entirely.

When milking is discontinued, the cows udder will fill up until a pressure great enough to stop secretion is established in the gland. After secretion is halted the milk is gradually resorbed from the gland until it becomes dry. When a cow's production is not more than two gallons of milk daily, it is a mistake to milk her out during the resorption period, as this releases the pressure within the gland and secretion of milk will start again.

It will help materially in drying off a heavy and persistent milker to reduce the amount of roughage fed and eliminate the concentrates entirely. Cutting down the water supply is also a help. As soon as the cow is dry she should again receive a normal ration.

A good dairy cow will produce considerably more milk annually if dried off before freshening. It usually pays to give a cow in poor flesh an eight week rest period.

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Calves Prefer Oats

Condensed from The Shorthorn World

A. D. Weber

Kansas State College

WHICH do calves prefer, oats or corn? And does it make any difference if these grains are ground? Two lots of four steer calves each were given an opportunity to answer these questions in a 138-day feeding trial that closed April 12, 1938, at the Kansas Agricultural Experiment Station.

The same amounts of atlas sorgo silage, cottonseed meal, and ground limestone were fed to both lots. In addition to these feeds, Lot 1 received whole oats and shelled corn, while Lot 2 received ground oats and ground shelled corn. The grains were hand-fed the first 18 days and self-fed free choice thereafter.

What were the results for the entire 138 days? The total grain consumed per steer daily in Lot 1 was 8.79 pounds, of which 64.3 per cent was whole oats and 35.7 per cent shelled corn. Average daily feed consumption was calculated for five periods—four 28-day periods and a final period of 26 days. The calves ate more whole oats than shelled corn in each period, though the difference was so slight in the third period that it can not be considered significant. The difference was highly significant in the final period for the total average daily grain consumption was 10.97 pounds of which 77.7 per cent was whole oats and 22.3 per cent shelled corn.

The same trend was noted in Lot 2 where the ground grains were fed, but the differences were not as striking as in Lot 1. For the entire 138 days the total grain consumed per steer daily in Lot 2 was 9.19 pounds, of which 55.4 per cent was ground oats and 44.6 per cent ground shelled corn. Approximately equal amounts of the ground grains were consumed in one period; somewhat more ground shelled corn than ground oats in one period, and considerably more ground oats than ground shelled corn in three periods. In the final period the total grain consumed per steer daily was 12.13 pounds of which 60.4 per cent was ground oats and 39.6 per cent ground shelled corn.

What is the significance of these results? Interpreted in the light of other experiments with

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oats, the results of this experiment indicate that calves being fattened for market can not be depended upon to select oats and corn in the proportion that produces maximum finish. Experimental data indicate that for best results oats, because they are rather bulky, should not comprise more than one-third by weight of the grain portion of the ration. Yet in this experiment the calves preferred oats to corn, hence ate significantly more oats than corn when these grains were self-fed free choice.

The correct proportion of oats to corn is maintained quite well if oats is the only grain fed during the first half of the feeding period when calves are being brought to a full feed and corn the only grain fed during the second half when the calves are larger and are being crowded on grain. Feeding oats and corn in that manner has produced excellent results in test at the Kansas Agricultural Experiment Station.

The results of this feeding trial are in agreement with the results of other tests conducted at the Kansas Station in that there was no benefit derived from grinding oats and corn for calves. The steers in Lot 1 fed the whole grains gained 2.36 pounds per head daily, and those in Lot 2 fed the ground grains 2.32 pounds. Since slightly more ground grain than whole grain was eaten with no increase in gain and since a charge must be made for grinding, the cost of gain was higher in Lot 2 than in Lot 1.

Pork-Makers

Condensed from Successful Farming

Irvin J. Mathews

THE Indiana Farm "Bizometer" is a chart, a yardstick, by which any farmer may learn how he rates as a manager. Transcribe to the chart the results which are contained in any individual farm record book and you immediately have a measure of the farmer's financial ability with respect to the seven principal factors of management: (1) value of crops per tillable acre; (2) crop-yields index; (3) feed fed per tillable acre; (4) livestock efficiency index; (5) farm receipts per tillable acre; (6) operating expense per tillable acre; (7) the size of the farm in tillable acres.

Three hundred and fifty of the best farmers in the State were gathered at the Florea farm in

Reprinted by permission from Successful Farming, July, 1938, Des Moines, Iowa

Fayette County during the Indiana Farm Management Tour to learn how Lee Florea, Purdue graduate of 1924, had fared on his Farm "Bizometer."

"Lee has consistently maintained a lead way above average in six of these factors," said the announcer to the farm-managers. "For 10 years he has turned off an average of 353 fat hogs of his own raising each year."

In 10 years on the farm Lee Florea has become one of the most successful all-around livestock farmers in the Midwest.

He is best known as an expert pork-producer. From his farm records, the information was divulged that his average receipts from Woodbine Farm during the last seven years show 78 percent in the form of finished pork.

"Efficient pork-making," Florea says, "depends much upon field arrangement and farm management. The underlying feed foundation for our hogs is our 75 acres of corn, 60 acres of wheat, 10 acres of oats, and about 75 acres in legumes, approximately two-thirds alfalfa and clover for pasture and one-third soybeans. The soybeans we either use directly or trade for tankage or meat scraps to balance the rations."

Strict sanitation is a religion with Florea. Nearly every field on this farm is or can easily be fenced to encompass running water and copious shade.

During the winter the sows kept for mothers get plenty of exercise and are fed a mixture of corn, oats, and alfalfa hay plus mineral, and the trinity mixture of one-half tankage, one-fourth linseed meal, and one-fourth ground alfalfa. Sometimes soybean oilmeal is substituted for the linseed oilmeal.

Florea's mineral mixture is 10 pounds of finely ground limestone, 10 pounds of bonemeal, 1 pound of salt; and for each 100 pounds of this, 5 pounds of baking soda and 2 pounds of powdered charcoal are mixed.

"Houses," said Florea, "all are movable. After trying a number of different sizes and shapes, I finally settled on a six- by seven-foot house which has sloping sides, a guard rail in the rear, one at the side of the front door, with the door at the extreme left when you are facing the house. Then there's a door in the roof to funnel those stray sunbeams into the house in the early spring.

"During March and April when the sows are farrowing, the ration is a mixture of 30 pounds of oats, 25 pounds of bran, 20 pounds of the trinity mixture, 15 pounds of shelled corn, 3 pounds alfalfa meal, and 5 pounds linseed oilmeal. The suckling pigs have access to a creep around a self-feeder loaded with a mixture of 7 parts ground corn,

2 parts ground wheat, and 1 part tankage.

"Painless weaning," Florea said. "When the pigs are six weeks old, the sows are taken out of the field and put in a woods pasture by themselves. With diluted, condensed buttermilk in a fountain, tankage and corn in a self-feeder, and lush rye pasture, the pigs don't miss them. For a little while tho," this owner pointed, " it's just one shock after another, for we castrate, wean, and vaccinate for cholera all in a space of a week or 10 days. Nothing can take the place of buttermilk then—really it is 'Pig Cheer' and I keep it in a 50-gallon barrel fountain before them all the time."

This man uses many temporary fences and shifts them around over the farm quickly and easily. It's easier and better than hauling feed.

"Good pasture will cut the tankage required by the hogs right in two," he mentioned. "For one lot of 170 hogs we were fattening, it required but 1,100 pounds of tankage to supplement the corn." And here's an immensely practical point from this man's book of experience: "We keep our pastures fresh during the entire season by clipping sections of it every 10 days or two weeks, about five times during the summer. During a dry spell, when the clover and alfalfa make little growth, tankage consumption will shoot up; then a few days after a refreshing rain, the shotes desert the tankage feeder and go to the clover almost exclusively. Pasture management is one of our biggest economies."

"Your pasture mixture?" I asked.

"Rather a shotgun affair," he replied. "Last year we mixed red clover, alfalfa, timothy, and lespedeza. We did not think much of the lespedeza when we mixed it, but it came thru the drought and made a lot of pasture where the other plants killed out. The hogs sure found it and converted it into pork. Of course, we sow oats and rape for early spring pasture, but the hogs eat the oats and merely nibble at the rape. We never can make the number of hogs and acres of rape come out even."

Fall pigs are easily raised on this farm. They are also farrowed in wooded lots not used oftener than once in three years. The pigs come in August or early September and pasture clover and alfalfa, which gets them ready for the winter in vigorous condition.

Silver Fox Farms

Condensed from The Nebraska Farmer

George Dobry

NOT so very many years ago, the silver fox pelt was secured only by trappers in certain parts of Canada. Because of its relative scarcity, and the exceedingly fine and artistic quality of its fur, the silver fox became highly valued for its pelt.

Today a pelt is worth anywhere from $20 on up; the figure may reach $2,000, or even more. Fox farms have cropped up in many parts of the nation. Various associations have promoted the popularity of silver fox, so the demand for this fur has been kept quite even with production.

Silver fox raising is an exacting business. It requires expert knowledge about the animal. It requires patience and scrupulous cleanliness in the care of the animal. It requires skill in pelting so that the silver fox pelts may auction well.

Silver fox raising is also a fascinating business. Let's take a look at the production of a beautiful fur, from mating of the parents through to sale of the pelt, as it takes place in a typical season at the Stuart Silver Fox Farm, the largest fox ranch in Nebraska.

The male and female fox are paired late each fall. That is, pairs which have been breeding well and producing good litters possessing quality pelts are kept for another season, and young animals whose parents have good production records are paired off to replace the older pairs and those that failed to whelp. The breeder knows the pedigree and whelping record of every animal through use of a tattoo indentification system. The tattoos are made on the animal's ear.

Each pair is assigned an individual pen, 24 by 50 feet in size. When unusually large litters are produced, the family is moved into a pen 50 by 50 feet. The gestation period is 52 days. The pups begin appearing in March and whelping is over in June. Litters vary from two to nine pups, the average for those breeding on the Stuart farm being about five. The pen average is less, a little over four, because many pairs fail to produce a litter.

In 1937 this farm marketed 780 pelts. This year the pup count totaled 850, making the fox population at the ranch this summer just over 1,250 animals.

Reprinted by permission from The Nebraska Farmer, July 30, 1938

When the pups appear, the vixen nurses them and keeps them in the kennel for a period of about 3 weeks. She does not allow the male to enter her kennel during this time. He brings food to his mate and the young in his mouth for the portion of the 3 weeks that the female is unable to leave her nest. The pups weigh only a few ounces at birth and in 8 months mature into an animal weighing from 12 to 16 pounds.

The kennels are built of wood and, except during the winter when they are bedded, the animals live on the bare boards. The kennels rest on props off the ground, and are reached by small runways; they are disinfected once each year and are regularly cleaned every 10 days.

The unique appetite of a fox is satisfied in the one feeding each day which the animal gets late in the afternoon. At the Stuart farm this consists of a ground and mixed ration including fresh horse meat, bone, tripe, sprouted oats, raw carrots, dried figs, and a commercial fox feed. The horse meat and fish make up half the ration. Nearly 200 head of horses are slaughtered each year. The fox likes both fruits (you recall the fable of the fox and the grapes?) and vegetables— and gets both at his meal. An elaborate feed house, which includes electrically cooled lockers and a large grinder and mixer, was erected last year.

An adult fox gets 1 pound of this mixture each day. The pups receive less, but their portion is increased as they mature. One feeding pan is allowed for each pen; this pan is cleaned and scalded each day. They are given water sufficient for the needs of the family. The fox consumes his food daintily, and is not one to gorge himself.

The confining pens are just that. The fine meshed woven wire serves as everything except a ceiling. In defining the size of the pen it extends 7 feet high, and overhangs inwardly more than a foot to prevent the animals from scaling the fence and leaping out. To keep the fox from burrowing out, the woven wire is also laid a few inches underground over the entire dirt floor of the pen. Once in a while a fox will escape, but a high wire enclosure, also with the overhanging lap, bounds the entire 20 acres in the farm and prevents the animal from getting away. Approximately 40 miles of woven wire fence is used on the place.

The fox is a close relative of the dog, and is subject to the same diseases and parasites. Distemper may wipe out a large number in a herd. As a matter of routine the animals are dipped and treated for roundworm and

hookworm. The lungworm is a potential enemy. At the Stuart farm everyone entering the tightly fenced farm must put on rubbers to prevent introduction of any new infection. Visitors are not encouraged.

Cleverness of the fox is proverbial. It has no natural enemies; man, who has hunted the fox for centuries, is its chief nemesis, as well as exploiter. Some investigators have tried to explain the dexterous mind of the fox in terms of the wiliness it has been forced to develop to elude man. But this doesn't explain many of its sly maneuvers, such as the way the fox out of captivity rids itself of fleas. The fox will grasp in its mouth a stick or some fluffed wool and gradually submerge itself in a pond, beginning with the tip of its tail. The fleas move forward to escape the water and finally are forced onto the object in the fox's mouth. The fox then sets it adrift, teeming with fleas, and makes off for shore.

Late in November and the fore part of December the silver fox pelt gets "prime." It is then that the skins must be removed, for the quality of the fur is at its peak. At Stuart the process of pelting 700 to 800 animals requires about 3 weeks. To kill the fox a solution of carbon tetrachloride is squirted up the nostrils. Each of the assistants has a role to perform in removing the pelt. (An expert hand, individually, can pelt a silver fox in 6 minutes.) The more delicate parts of the job include knife work about the claws and head, both of which remain with the pelt. The pelt is carefully scraped and cleaned, then pinned, hide out, on a stretching board for 48 hours; it is then turned, fur out, and shaped, and left on the board for 24 hours. The pelt is last hung to dry in a cool room until it is shipped.

Furriers will pay more for a pelt that is "full silver"; that is, one that possesses a distinctive silver sparkle over a large part of the pelt; also for minimum of underfur, long guard hairs, and long silver bands on the guard hair.

Guard hairs are those which cover the heavy, ultra-fine underfur. Below the black tip on the guard hair is a silver band, which varies in length on different animals. The black coloring on the hair takes up again below the band. Thus the guard hair is black, with a strip of silver in the middle. It is this band which lends the beautiful coloring to the soft fur of the silver fox. Animals are bred to secure a lengthening of the silver band.

Today 90 percent of the pelts are used for trim on women's wearing apparel, 10 percent as "wraps." This is a reverse of the

situation prevailing not so many years ago. Less emphasis is placed on the "brush," or tail, than heretofore. Pelts bring anywhere from $50 to $200, some of course going below and some above these figures.

Most fox breeders are more interested in the production of quality pelts than in any extended expansion of their farms. Pelts are now produced on a scale never before approached in the United States, and to command a respectable price the pelt must be of exceptional quality.

A pair of good foxes for breeding purposes is obtainable at a price ranging from $500 to $1,000.

Lubricating Oil

Condensed from The Montana Farmer

LUBRICATING oil is an increasingly important adjunct to the operation of modern farms. Increased use of modern machinery and vehicles of transportation upon which the operation of the farm is based have led to higher requirements for the lubricants upon which their successful operation depends. The leading oil refiners have worked hand in hand with the machinery and automotive manufacturers to produce oils of correct specifications for specific and exacting tasks.

There are two methods to follow in selecting oils and greases for particular jobs that will enable the truck, tractor or automobile owner to know that he is making an intelligent purchase of this highly important material. One method is to make a thoroughgoing study of the qualities that make good lubricants, the chemistry of petroleum refining and of what happens to oils and greases after they are applied to bearings.

It will appear at once that uniformity of the product is a prime essential. It will be seen, also, that many technical details must be followed scrupulously in the manufacturing process to insure the uniformity of quality.

The appearance of oil does not afford adequate evidence of its purity or lubricating value. Therefore, the operator of automotive equipment usually finds that his best assurance of getting the oil he should have is to confine his

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purchases to the brands of known standards and qualities and, until he becomes well experienced in the use of lubricants, follow the advice of his oil dealer as to what weight and grade to buy for each particular use.

One would not long patronize a dealer who sold lubricating oil containing acid that would corrode or otherwise injure the surface of bearings, cylinder walls and other vital parts of expensive automotive equipment. No reputable dealer would sell such a product deliberately, yet the fact remains that imperfectly refined oils often do contain materials that undergo chemical change in the heat and vapor of the crankcase to produce sulfuric acid. This kind of oil doesn't necessarily look any different from oil that is safe and efficient, and the presence of such improper matter cannot be detected except in a chemical laboratory.

Damage from this source, or any other damage connected with oil failure, usually is not discovered until long after it has taken place. Unless special examination is made, it may never be discovered and may only be suspected from mounting costs of operation, greater oil requirements and unsatisfactory performance.

A notable development of the past few years has been the improvement of automotive engines to the point where parts are very close fitting, requiring lighter lubricants than formerly. Most new automobiles require oil of an S. A. E. rating of 10, whereas in years gone by, oils of much heavier grade were commonly used. Although light oils are required to penetrate the exceedingly small clearances of modern precision manufacture, oils of unusual toughness are also essential to stand up under the heat and punishment of high speed, high compression operation. This is another quality which cannot be determined from casual examination, but which must be manufactured into the product by skilled methods. The greatest assurance of getting this necessary quality is had when products of known manufacture and reputation are used.

S.A.E. ratings are now generally understood by oil purchasers, but a few words as to the method of determining these ratings may be of value. S. A. E. refers to the Society of Automotive Engineers. This group of impartial engineers have established standards for many products used in connection with automotive operation, including lubricating oil. They have divided the weights of oil commonly used in lubricating internal combustion motors into six divisions, beginning with S. A. E. 10, and advancing by tens to S. A. E. 60, the heaviest

weight commonly used. The numbers of the various weights of oil represent the viscosity or "body" of the oil, and this is determined by the length of time required for a given amount of oil at a given temperature to flow through an opening of a certain size. The lighter and more fluid oils naturally run more rapidly.

The flash point and cold test are the two remaining terms used in describing the characteristics of different oils. The flash point is the temperature at which vapors are given off that will flash when brought in contact with flame. It is necessary that the flash point be higher than the normal temperature of the working parts of the motor. The higher the flash point for any given weight of oil, the greater its toughness, as a rule.

Cold test indicates the efficiency with which oil lubricates at low temperatures, as during the warming-up period. The lower the cold test, the lower the temperature at which satisfactory lubrication will be had. Presence of wax in the oil, another invisible characteristic, will reduce the lubricating value at low temperatures as the waxy materials tend to congeal and impede the flow. High grade oils are now dewaxed in the refining process, and the purchaser of such oils need have no fear on this score.

It will be seen that regardless of one's technical and chemical knowledge of oil, so many of the important factors in regard to oil quality cannot be determined except by elaborate scientific analysis that reputation of the manufacturer and seller is about the only practical basis of judgment in the purchase of oil. The importance of oil is out of proportion to its relative cost and deserves more care in its purchase than other materials requiring about the same outlay.

While quality is always the first consideration, it does not follow that all automotive equipment requires the highest quality oil obtainable. New equipment does deserve the best, but if improper lubrication in the past or long years of service have taken the greater part of the value out of a motor and have rendered it extravagant in its consumption of oil, there is little to be gained from feeding it a premium grade. The reliable refiners have developed lower cost oils for use in such equipment as this. The important point to remember is that the companies offering the regular, established, advertised brands not only have the technical knowledge and equipment to produce the best value in motor oil, but have highly valuable reputations which they must sustain without fail.

Flash Pasteurization of Apple Juice

Condensed from Farm Research

Donald K. Tressler and Carl S. Pederson

FOR centuries sweet cider has been one of the most popular of autumn beverages. Until recent years there has been no simple means of preserving this beverage for use in other seasons. Freezing and storage at 10° F or lower is now recognized as an excellent method of preserving this juice so as to retain all of its fine flavor and aroma. However, freezing preservation has the obvious disadvantage of requiring continuous refrigeration. This causes certain marketing difficulties which limit the applicability of the method.

More recently good methods have been employed for preserving cider previously clarified with enzymes, gelatin and tannin, or by flash heating and filtering. These methods are of two types, one involving bottling and holding pasteurization, the other simple filtration of the previously clarified product thru special asbestos paper pulp pads (Seitz E K sheets or equivalent). These methods of preservation are excellent, but it must be recognized that the clarification of cider by any known means reduces its flavor considerably. Obviously, preserved clarified cider does not resemble closely the freshly made product which has not undergone clarification.

Until recently there has been no satisfactory method of pasteurizing freshly pressed cider. If the cloudy juice is pasteurized by the method involving holding the bottled or canned product at 170° F for 20 minutes or longer, a heavy sediment is deposited and the product loses its fresh apple flavor and takes on the aroma and flavor of apple sauce. Such a product is not inviting.

About two years ago Professor W. V. Cruess and assistants at the University of California indicated that California cider could be satisfactorily preserved by flash pasteurization at 185° to 195° F followed by canning at 165° F. This procedure represented a distinct advance in the preservation of cider since this short period of heating did not cause the deposition of a large amount of sediment nor did it cause the development of flavors resembling those of cooked apples. Further, it demonstrated the fact that the type L charcoal plate can lined with sanitary or

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berry enamel is a satisfactory container for cider made from western apples. More recently, Dr. R. E. Marshall, of the Michigan State College, has demonstrated that the clarified juice of eastern apples can be satisfactorily preserved by flash pasteurization at approximately 185° F.

Development of Process

Preliminary studies at this Station on the rate of killing micro-organisms during pasteurization of apple juice have indicated that, by the time juice reaches 145° to 150° F all of the yeasts and practically all of the bacteria have been killed; only a few mold or bacterial spores appear to survive at this temperature. This experimental work seemed to indicate that flash pasteurization at temperatures considerably below that employed by the University of California workers would effectively preserve apple juice.

With this work in mind the flash pasteurization of freshly pressed apple juice at several different temperatures was studied. Freshly pressed, unclarified juice from Baldwin, Greening, McIntosh, and King apples was strained thru muslin and then flash pasteurized by running the juice thru tubes maintained at the desired temperature by hot water. Approximately 1 minute was required for the juice to pass thru the heated tubes. From the flash pasteurizer the hot juice passed into a small reservoir from which it was immediately run into type L charcoal plate cans lined with sanitary enamel. These cans were filled completely and immediately closed, inverted for 3 minutes, then cooled in water.

Even when the flash pasteurization was conducted at 150° F, none of the completely filled cans spoiled. Apple juice in cans partially filled at this low temperature did not keep. Tests at other temperatures showed that apple juice flash pasteurized at 160° to 170° F was slightly better in flavor than that pasteurized either at a higher or lower temperature.

Upon standing, a small amount of sediment was deposited in each can. In order to reduce the sediment to a minimum it is recommended that firm apples be used and that the freshly pressed juice be carefully strained prior to flash pasteurization.

Altho the product obtained by this procedure is cloudy and consequently may not appeal to the eye as does the clarified product, yet it is of far better flavor than the very best clarified apple juice. In fact, it is difficult to distinguish between this flash-pasteurized juice and the freshly pressed product.

Homemade Pasteurizer

A simple inexpensive flash pasteurizer can be made by placing

a 50-foot aluminum or copper coil fitted with a faucet into a 50-gallon headless barrel filled with water heated to approximately 10° F higher than the desired flash pasteurization temperature. The water surrounding the coil in the barrel may be heated by the direct introduction of steam. Strained apple juice is placed in an elevated barrel or tank at least 6 feet above the level of the coil. This juice is run from the upper barrel by a hose connected to the inlet end of the coil. The temperature of the apple juice entering the cans may be adjusted to the desired point by opening or closing the faucet. This simple flash pasteurizer can be constructed at a cost of $10 to $15.

Cider is an old-fashioned name for a product which only too often is mediocre in quality. In order to fall in line with the recent terminology for fruit juices, such as pineapple, orange, and other juices which have recently captivated the public fancy, it is suggested that the flash pasteurized product be labeled apple juice.

Fertilize Ornamental Trees

Condensed from The Ohio Farmer

F. W. Dean

MOST shade and ornamental trees will thrive in deep porous soils, high in organic material or humus and supplied with a normal supply of moisture during the growing season. Trees kept in a thrifty, vigorous growing condition will throw off attacks by insects and diseases, while those that are unhealthy and low in vitality invite injurious disease and insect pests.

In many instances the lack of moisture or water is the chief trouble. Merely sprinkling the soil and root system does little good.

In watering trees, it should be done thoroly, but not too frequently. Artificial watering with the hose, thoroly soaking the soil every 10 days or two weeks, is recommended rather than frequent sprinkling. This, of course, is dependent on the season's normal rainfall. It is estimated that a large-sized tree with open crown, will throw off during the summer 10 barrels of water on a hot summer day. In order to supply this amount of moisture, one can easily calculate the tremendous quantity of water a single tree requires during the growing season.

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Fertilization

Most trees are undernourished and lack proper minerals in the soil, which are necessary for healthy normal growth. Even if the trees receive a normal supply of water during a growing season they still may be starved and need the proper food elements for healthy growth.

Data by experiment stations and professional tree specialists show that trees respond actively to commercial fertilizers high in nitrogen content. Usually a 10-6-4 mixture is recommended—10 percent nitrogen, six percent phosphorus, and four percent potash—for best all-round purposes and tree growth. This should be applied early in the spring—April, and if needed, another application from the middle of May until July 1. Later applications in the summer may stimulate new wood growth that would be exposed to winter freezing. However, a late application could be made from October to the middle of November. This would greatly supplement early spring fertilization, since roots are active up until midwinter, altho the trunk and branches of the tree remain dormant during the winter season.

The rate of application varies according to size of tree. Usually one pound of 10-6-4 per inch in diameter of the tree is a safe rule to follow, altho experiments have shown that trees can consume fertilizers in greater amounts.

A straight nitrogen fertilizer such as sulphate of ammonia or nitrate of soda can also be used with good results. This should be applied early in the spring, at the rate of ½ pound per inch in diameter of the tree. A second application can be made in May or early June at the same rate.

The mixed fertilizer, 10-6-4, should be applied by punching holes in the ground with a crowbar and then pouring small amounts, ¼ to ½ pound, in each hole until the required amount has been completed. A small hand trowel or cup can be used, inserting fertilizer in each hole. The holes should be dug 12 to 16 inches deep to reach sub-surface rootlets and spaced 2½ to 3 feet apart, depending upon the amount of fertilizer required.

Post hole diggers can also be used in making the holes. This makes a larger sized hole and is unsightly on lawns, but covers the area more quickly than the crowbar method. After inserting the fertilizer, soak holes by artificial watering or apply just before rains. The holes later can be capped or filled with porous material such as sand, or better, peat moss. In this way they can be reopened and filled with fertilizer as needed.

If straight sulphate of ammonia or nitrate of soda is used,

this can be broadcast and then immediately soaked into the ground by artificial watering.

These nitrogen chemicals filtrate into the soil easily by watering, while a mixed fertilizer with phosphorus and potash moves slowly downward to the root system of the trees.

The fertilizers should be placed under the crown or canopy of the trees, starting about 10 feet from the trunk (large trees) and applying in a circular ring or band clear to the tip of the outer branches. It is most important that the bulk of fertilizer be placed in a circular band at the outer edge or "drip" of the branches, as this is the area where the active feeder roots are located. The outer branches of the trees correspond closely to the outer zone of active roots that absorb from the soil the necessary mineral requirements.

Mulching

Both deciduous and conifer trees need a plentiful supply of humus and organic material in the soil. This can be supplied by applying deep layers of well decayed manure six to eight inches, in the fall or early winter, and then spading it into the soil the following spring or early summer. This can be repeated each season until a high humus and organic content of the soil is built up. Leaves and compost soils can also be used. Peat moss is also an excellent mulch to use, especially where trees and shrubs need an acid soil. However, it must be remembered that peat moss is not a fertilizer, but will only improve the organic condition of the soil.

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